

# The AMSAT<sup>®</sup> Journal

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Volume 20, No. 6

November/December 1997

## CONTENTS

**Canada Welcomes AMSAT!....1**  
*By Robin Haighton, VE3FRH*

**Apogee View.....3**  
*By Bill Tynan, W3XO*

**Ariane 5, A New Success  
Story Begins.....7**

**38k4 Receiver  
Requirements.....9**  
*By J. Paffett, Chris Jackson, and  
Z. Wahl*

**KI0AG Micro-Duplexer.....12**  
*By Chuck Duey, KI0AG*

**AO-27 from England and  
Scotland.....14**  
*By Ray Soifer, W2RS*

**Field Ops Update: Area  
Coordinator Success  
Stories.....16**  
*By Barry Baines, WD4ASW*

**A Stripline Filter for the  
Mode-J Operator.....18**  
*By John Hackett, LA2QAA*

**Satellite Orbital Elements.....21**  
*By Ray Hoad, WA5QDC*

**S-Band From DOVE as a Test  
Signal.....23**  
*By Jim White, WD0E*

**Report on the IARU  
International Satellite  
Forum.....24**  
*By Hans van de Groenendaal,  
ZS5AKV*

**AMSAT Journal Telemetry....26**

**Phase 3D Photos.....31**



AMSAT President Bill Tynan, W3XO (l) presents a Phase 3D contributor plaque to AMSAT-UK Secretary Ron Broadbent, G3AAJ (r) in appreciation for AMSAT-UK's constant financial support to the Phase 3D project. Upon accepting the plaque in behalf of AMSAT-UK, Ron said that the plaque would be displayed in the offices of the Radio Society of Great Britain. (KC5JVB photo)

## Canada Welcomes AMSAT!

**By Robin Haighton VE3FRH**

*ve3frh@amsat.org*

Over 200 persons attended the 15<sup>th</sup> AMSAT Annual Space Symposium and Annual Meeting in Toronto, Ontario from October 17-19, 1997. Participants from twelve countries converged on the Delta Hotel located near Pearson (Toronto) International Airport to hear a variety of presentations on various AMSAT topics.

From Friday morning until Saturday afternoon, the following technical presentations were given:

- *The International Space Station and New Canada Arm, Ashley Rego, SPAR Aerospace*

[continued on page 4]

AMSAT-NA  
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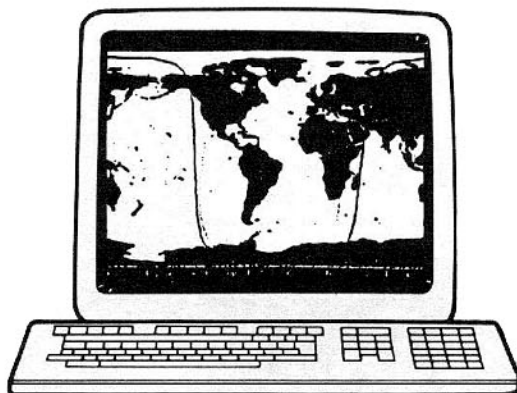
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AMSAT-NA can take your order for a Kansas City Tracker/Tuner or one of many Satellite Tracking software packages that support the KCT, such as Quiktrak, Graftrak, and WiSP for Windows. When you order thru them, they receive a Donation in your name towards the Phase 3D Project. Their telephone number is 301-589-6062.



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600, Silver Spring, MD 20910-4703.

*The AMSAT Journal* (ISSN: 1407-3076) is published bi-monthly (Jan, Mar,  
May, Jul, Sep, Nov) by AMSAT-NA, 850 Sligo Avenue, Silver Spring, MD  
20910-4703. Telephone: 301-589-6062, fax: 301-608-3410. Periodicals  
postage paid at Silver Spring, MD, and additional mailing offices. Postmaster,  
send address changes to *The AMSAT Journal*, 850 Sligo Avenue, Suite 600,  
Silver Spring, MD 20910-4703.

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material for *The AMSAT Journal* based on suitability of content and space  
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their talents, time, and efforts to produce *The AMSAT Journal*.

## Apogee View

### Still, A Little More to Do by Bill Tynan W3XO

With the launch of the European Space Agency (ESA) Ariane 502 having taken place on October 30th, there is renewed anticipation that Phase 3D will go sometime next year.

As ESA reviews the flight records and plans are laid for future Ariane 5 flights, the finishing touches are being put on the Phase 3D satellite, including making final adjustments to flight systems and completing the spacecraft structural changes made necessary by ESA's announced increased environmental conditions. Recall that these changes, which we first learned of in February of this year, were based on the information the European Space Agency obtained from the telemetry records gathered during the short flight of Ariane 501. It is obvious that they did not want to publish any information on revised environments until they had an opportunity to conduct a thorough review of the limited data they had available. Once they did have such information, it was provided to us. Our evaluation of its implications and subsequent designing and installing the parts necessary to meet the new increased loads has taken until the end of October. However, this time has also presented us with the opportunity to review our original structural designs and make worthwhile improvements which, if not absolutely necessary, certainly would have been worthwhile under any launch scenario.

The additional time that had to be expended to determine what needed to be done and to accomplish the required tasks, also afforded us the opportunity to review some of the other aspects of the Phase 3D design and even increase the satellite's capability. For example, now, there will be two S-Band transmitters, each with its own independent antenna. Among other advantages, this addition provides redundancy for this all-important downlink. The second unit came as a result of the recent work done by a group in Germany. Other activity has involved more refined analysis of the spacecraft's thermal environment under all of the various conditions it will face. Results of this has shown that changes are necessary to assure the maintenance of proper temperatures, particularly during the time the spacecraft is spinning, prior to solar panel deployment. Design of modifications necessary to improve this situation is on-going.

Of course all this additional work has required time and money. It has necessitated effort to install and remove electronic sub-assemblies several times in the process of conducting installed system tests and still continue the structural work. It goes without saying that it is critical that these de-installations and re-installations required extreme care to ensure that no components, or the spacecraft wiring harness, were damaged; and that all installations were performed correctly.

The above account should serve to illustrate the point that building a satellite involves painstaking work and the expenditure of a substantial amount of money.

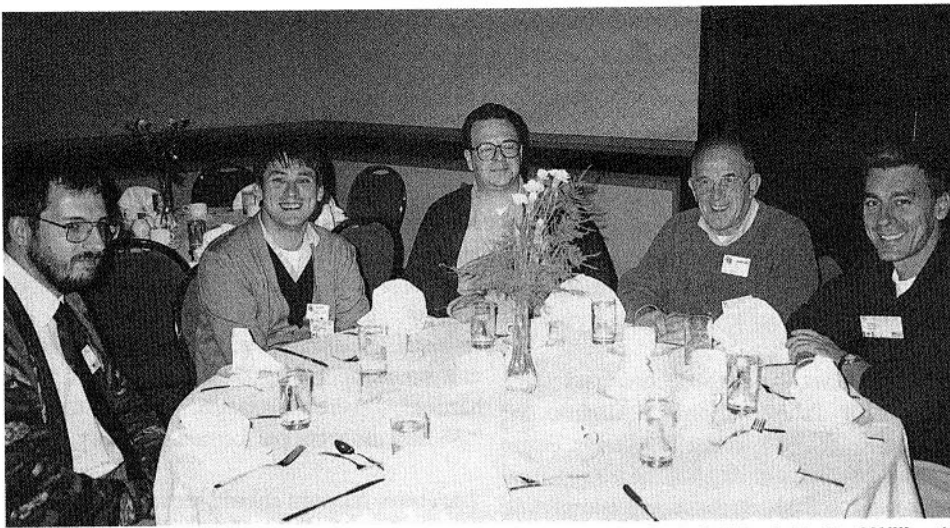
While much of this may seem obvious to many of you who have followed the Phase 3D story, I believe it worth repeating, if only to emphasize the difficulties and opportunities presented by the various delays, changes and re-works. This work has taken time, and costs money. But it has been both necessary and beneficial!

We are hopeful that the launch of Phase 3D will now take place before mid 1998. Negotiations with ESA are currently underway. Meanwhile we at AMSAT-NA must keep paying our share of the bills, as we know our partners, the other participating AMSAT organizations are doing.

Based on the best available estimates, and assuming that launch goes off as speculated above, we believe that AMSAT-NA will need an additional \$270,000 U.S. Dollars to assure meeting our share of the costs, including the substantial sum necessary to support a launch campaign. That's \$270,000 over and above the funds already raised by previous AMSAT-NA and ARRL fund raising efforts.

All AMSAT-NA members should have already received a letter from me saying pretty much the same thing as this editorial. In it, I ask that everyone make one final contribution to assure the completion and launch of Phase 3D. Based on the knowledge that every member will be unable to contribute the full amount asked for, a figure of \$100 for each member is suggested. If this level of contribution, by even half of our members, can be achieved, it should offset the \$270,000 shortfall. I believe that everyone will agree that \$100 is a small price to pay when one considers the many happy hours Phase 3D will bring us once it's in orbit and released for general use by the world's amateurs.

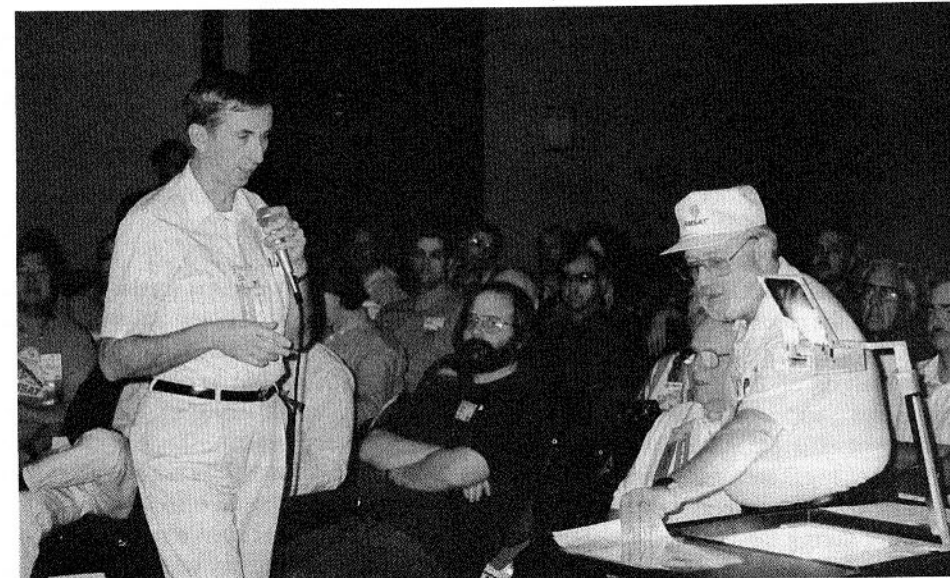




AMSAT-Italy was well represented at the AMSAT-NA banquet. From left to right, Paul Willmott, VP6MU, Luca Bertagnolio, IK2OVV, Carlo De Bartholomaeis, IW2CTJ, Oscar Pelizzoli, I2PZB, and Alberto Zagni, I2KBD. Alberto is Project Manager for IO-26. (KC5JVB photo)



Participants came from near and far. From left to right, Saif Shahid, S21A, Bangladesh; Ken Pulfer, VE3PU, Ottawa; Eddie Pettis, N5JGK, Mississippi; and Chuck Duey, KI0AG, Colorado. Saif is the first licensed Amateur Radio operator in Bangladesh while Ken is Treasurer of the Radio Amateurs of Canada. (KC5JVB photo)



AMSAT Vice President for Engineering Stan Wood, WA4NFY (l) and Phase 3D Integration Laboratory Manager Lou McFadin, W5DID (r) provided Symposium participants with a detailed briefing on recent Phase 3D activities. (KC5JVB photo)

It goes without saying that contributions of more than \$100 will be most welcome. On the other side of this coin, no one should feel that, if they are unable to give this additional \$100, their help will not be welcome. All should feel free to help with the completion and launch of Phase 3D with as little as \$10, if that's all they can afford to, or are willing to, give right now. As a special inducement, for answering this final Phase 3D fund raising appeal, all responding to this last plea will be sent a Phase 3D decal, and, receive my personally signed letter of thanks.

And, please don't forget the other incentives that AMSAT-NA makes available to those who contribute to Phase 3D. Those contributing a total of \$2,500 U.S. or more directly to AMSAT-NA, will have some piece of spacecraft hardware, usually a row of solar cells, dedicated to them. As evidence of this dedication, they will receive a beautiful 13 x 20 inch plaque featuring a large depiction of the satellite as it will look in space with solar panels deployed. Over a dozen of these plaques have already been distributed. Those who contribute \$1,000 U.S. or more, directly to AMSAT-NA, will receive a special plaque noting their specific contribution.

Since all previous Phase 3D contributions, made directly through AMSAT-NA, count toward these totals, you may already be most of the way there. Martha at the AMSAT office (301-589-6062) can supply information on amounts previously contributed.

Remember, that under U.S. Internal Revenue Code, AMSAT-NA is a 501(c)(3) organization. This means that funds donated to Phase 3D by U.S. taxpayers may be deductible as charitable contributions. But, be sure to check with your tax preparer, or advisor, before taking any such deduction. Investigations are underway in Canada to determine what might be done so that Canadian contributions might also be deductible, but, no such arrangement is in place at present.

However, whether you live in the U.S., Canada, or anywhere else in the world, please help make Phase 3D the reality that we have all been striving for. Look over the letter you have recently received and please respond to it to the best of your ability.

I thank you, and all who have been working on Phase 3D thank you. Hams all over the world will thank you. And, you will thank yourself beginning with your first QSO through OSCAR-??.



**[Canada continued from page 1]**

- *Mobile and Portable Operations of Voice Mode Satellites*, Chuck Duey, K10AG
- *WATOO: An Internet Access of Software to a Satellite Station*, Marc Normandeau, Jean-Marc Desbiens, Michel Bardeau, and Steve Bernier
- *Satellite Technology for Newcomers: Using the Weather Channel as a Model*, Rich Moseson, W2VU
- *They Never Told Me Not To: An Innocent is Seduced by Centimeter Waves*, Laura Halliday, VE7LDH
- *The University of Toronto Astronomy Microsatellite Project*, Dr. Robert Zee
- *Object Oriented Approach to Automatic Radio Tuning*, Anthony Montiero, AA2TX
- *A Simple BPSK Software Modem*, Doug Quagliana, KA2UPW
- *Developing Portable Satellite Software Using JAVA*, John Melton, G0ORX
- *How the Internet and Free Software Help AMSAT*, Bdale Garbee, N3EUA
- *Design of a Space Imaging Processing System*, Robert Hillman
- *Design and Implementation of Internet-Linked Ground Stations for the Amateur Satellite Community*, Chris Bond and Mark Maier

In addition the following presentations were provided on the Phase 3D project:

- *Phase 3D Update*, Stan Wood, WA4NFY, Lou McFadin, W5DID, Bill Tynan, W3XO, and Keith Baker, KB1SF
- *GPS Receiver Progress Report*, Bdale Garbee, N3EUA
- *A Practical Guide to Phase 3D Operation on Mode L and Above*, Ed Krome, K9EK

Also, looking toward the future, the following presentations were devoted to discussing concepts associated with post-Phase 3D activities:

- *An EZ-SAT Proposal*, Fred Winter, N2XOU and Ken Ernandes, N2WWD
- *A Phase 4 Lite Proposal*, Philip Chien, KC4YER

- *Digital Voice Modulation for a Future Generation of Ham Satellites*, Dan Schultz, N8FGV
- *Selecting Orbits for LEO Constellations, SSB/CW Communications*, Martin Davidoff, K2UBC

- *A Candidate Orbit for Future AMSAT Spacecraft*, Ken Ernandes, N2WWD
- *Amateur Radio On Board the International Space Station*, Frank Bauer, KA3HDO and Will Marchant, KC6ROL

**— Many Thanks to the Following for Donating Prizes —**

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Kenwood Dual Band Mobile TM-V7A

ICOM America, Inc.  
Rosetta Laboratories, Australia  
Kenwood Canada

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Satellite Tool Kit Version 4.0 CDROMS (15)  
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Debian GNU/Linux 1.21. CDROM (4)  
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Logsat Programs (3)  
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NOVA Version 3.2 CDROMS (3)  
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Gift Certificate for 1,000 QSL Cards

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*In addition, all symposium participants were provided with a briefcase courtesy of Spar Aerospace and the latest issue of CQ VHF courtesy of CQ Magazine.*

In addition, on Sunday morning, participants were treated to an IARU Satellite workshop chaired by Hans van de Groenendaal, ZS5AKV, IARU Satellite Advisor and Member of Region 1 Executive Committee (the results of this workshop are provided on page 24).

Details of these presentations are provided in the *1997 Proceedings of the AMSAT-NA 15th Space Symposium* and are available from AMSAT-NA (see address on page 3). The cost is \$15 in the US; \$20 Canada/Mexico; \$25 elsewhere.

Saturday evening's banquet was a notable success with Hans van de Groenendaal, ZS5AKV giving an enjoyable talk on the innovative contributions that amateur satellites have made to Amateur Radio. Afterward, Bill Tynan, W3XO presented 19 members with plaques in appreciation for contributing over \$2,500 for Phase 3D. In addition, various awards were given to numerous members for their contributions in 1997. As usual, the evening banquet concluded with a multi-prize drawing. Grand Prizes were won by Ashley Rego (ICOM 821H donated by ICOM America, Inc.), Lou McFadin, W5DID (WinRADiO, donated by Rosetta Laboratories, Victoria Australia), and Ginny Southwell, G1LIT (Kenwood Dual Band TM-V7A donated by Kenwood Canada). It was noted that Ashley Rego, a symposium speaker, does not have a call sign. Inasmuch, his grand prize award has prompted him to become involved in Amateur Radio! A special thanks is in order for these and others who donated prizes for the banquet.

Leanore Guimont, KA6UCD presented Roy Welch, W0SL with the prize from the *5th Annual (and Traditional) Electronic Jewelry Contest*. Roy came closest to identifying the frequency of the *third hand bracelet holder* at 437.1275295 MHz, closely beating out Paul Shuch, N6TX and Eddie Pettis, N5JGK.

*The Canadian Team which organized the event, would like to thank all who attended, and hope that at some time in the future you will return to Canada for another similar meeting. We enjoyed being your hosts.*

**Make plans to attend the 16th Annual Space Symposium and AMSAT-NA Annual Meeting which is scheduled to be held October 9-11, 1998 in Vicksburg, Mississippi! Stay tuned for additional news via ANS, AMSAT-BB, WWW, and The AMSAT Journal. ■**

## Phase 3D Contributor Plaques

- AMSAT UK
- J.B. Archinard, KT4AT, North Carolina
- Central States VHF Society
- Dayton Amateur Radio Association, Ohio
- John Emrich, N2REC, New Jersey
- Joe Holman, AD7D, Washington
- James Jaeger, K8RQ, Ohio
- R.H. Knaack, Jr., W7FGQ, Washington
- Jim Larsen, K7GE, Washington
- Jim Marold, WB2TZK, APO
- Louis McFadin, W5DID, Florida
- Michael Owen, W9IP, New York
- Malcolm Preston, NP2L, Virgin Islands
- Stuart Rohre II, K5KVH, Texas
- Tucson Amateur Packet Radio, Arizona
- SCO, Incorporated
- U.S.K.A., Switzerland
- Rex Widmer, WB0IT, Kansas
- K.F. Zimmer, DC2ZG, Germany

## 1997 AMSAT Awards AMSAT Space Symposium & Annual Meeting

- Wayne Chandler, VE3WHC - Technical Sessions
- Norm Friedin, VE3CZI - Conference Planning
- Robin Haighton, VE3FRH - Conference Chairman
- Dan Henderson, VA3DH - Conference Planning
- Tom Montgomery, VA3TM - Moderator
- Gerry Pare, VE3GEA - Sponsorships
- Bob Parker, VE3OIP - WWW
- Ron Poppe, VE3IUI - Conference Planning
- Tom Watson, VE3CYL - Conference Planning

### Communication and Information

- B. J. Arts, WT0N - AMSAT News Service
- Paul Beckman, WA0RSE - P3 Guide to P3D
- Cliff Buttschardt, K7RR - West Coast 75 Meter Net
- Martin Davidoff, K2UBC - *The Satellite Experimenter's Handbook*
- Ray Hoad, WA5QGD - Keplerian Elements
- John A. Hackett, LA2QAA - *The AMSAT Journal*
- John Henry, VE2VQ - Canadian Coordination
- Ron Long, W8GUS - East Coast 75 Meter Net
- James Miller, G3RUH - IPS Book and AO-13
- Stacey Mills, W4SM - AO-10 & AO-13 Command
- Walt Rader, WA3DMF - AMSAT QSL Manager
- Martha Saragovitz - Corporate Secretary
- Jack Somers, KK6OH - Ground Station Equipment
- Russ Tillman, KC5JVB - *The AMSAT Journal*
- Al Tribble, W3STW - East Coast 75 Meter Net

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- Dee Interdonato, NB2F - NJ Area Coordinator
- Ed Krome, K9EK - Education and Training
- Roger Ley, WA9PZL - ARK/LA/TX Area Coordinator
- Gerald Schmitt, KK5YY - AO-27 Hamfest Demonstrations
- Jerry Smyth, N8ULU - Michigan Area Coordinator
- Howard Ziserman, WA3GOV - Hamfest Promotion

### Phase 3D

- T.J. Bailey, KF6IAO - Stable Mode Sun Sensor
- Barry Baines, WD4ASW - Integration Lab
- Jody Barker - Structural Modifications
- Alan Bloom, N1AL - Stable Mode Sun Sensor
- Tim Bosma, W6ISS - Stable Mode Sun Sensor
- John Breckenridge, WB6FRZ - Stable Mode Sun Sensor
- Kermit Carlson, W9XA - Machined Parts
- Phil Chien, KC4YER - Integration Lab
- Gil Carman, WA5NOM - Trajectory and Orbit Analysis

- Bob Carpenter, W3OTC - Fundraising Data Base
- Dick Daniels, W4PUJ - Propulsion System
- Robert (Bob) Davis, KF4KSS - Mechanical Design
- Pete DeLos Santos - Sensor Electronics Unit
- Robert Diersing, N5AHD - RUDAK
- Terry Dillahunt, K7TD - RF Cables
- Mike Dryton - Stable Mode Sun Sensor
- Steve Elliot - Structural Modifications
- Glen Elmore, N6GN - Stable Mode Sun Sensor
- Bruce Ericsson, KK6TG - 10GHz Transmitter
- Robert French, N8EHA - SSB Tests
- Bdale Garbee, N3EUA - GPS & RUDAK
- Chuck Green, N0ADI - Printed Circuits
- Steve Hageman - Stable Mode Sun Sensor
- Curt Helstrom, WA6TIP - Stable Mode Sun Sensor
- Chuck Hennessey, W4AT - Integration Lab
- Jim Hill, K6UUW - Stable Mode Sun Sensor
- Martin Holder - Sensor Electronics Unit
- Bill Holmgren, W0IOH - RF Cables
- Dave Hubbard - Stable Mode Sun Sensor
- Dick Jansson, WD4FAB - Mechanical & Thermal Design
- Lyle Johnson, WA7GXD - RUDAK Manager
- Phil Karn, KA9Q - RUDAK
- Albert Kong - Stable Mode Sun Sensor
- Jason Kovatch, N6BCI - Stable Mode Sun Sensor
- Jim Ladesic - Spaceframe Structural Analysis
- Kathy Larsen - Stable Mode Sun Sensor
- Jennifer Lemcke - Wiring Harness
- Richard Leon, KA1RHL - Liquid Ignition Unit
- Walter Lockhart - Sensor Electronics Unit
- John Lynch, W6CCY - Stable Mode Sun Sensor
- John McDonald - Sensor Electronics Unit
- Lou McFadin, W5DID - Integration Manager
- Clarence McGinnis - Sensor Electronics Unit
- Bruce A. Miller - Bending Procedures for RF Cables
- Dean Pachon - GPS Antennas
- Brad Potter - Stable Mode Sun Sensor
- Harold Price, NK6K - RUDAK
- Jake Sanderson, KD6BCL - Stable Mode Sun Sensor
- Santa Rosa Junior College - Stable Mode Sun Sensor
- Norma Shepard - Stable Mode Sun Sensor
- Hank Sill, AC4ZI - Spaceframe Modifications
- Karen Spencer - Stable Mode Sun Sensor
- Herb Sullivan, K6QXB - Stable Mode Sun Sensor
- Steve Todd, K2IYQ - Stable Mode Sun Sensor
- Scott Vangen, WB0QML - Liquid Ignition Unit
- Guy West, N0MMA - RF Preamps
- Jim White, WD0E - RUDAK & Structural Modifications
- Steve Whitelaw, KD6FYK - Stable Mode Sun Sensor
- Stan Wood, WA4NFF - Spaceframe Structure and SSB
- Denny Yamaoka - Stable Mode Sun Sensor
- Ray Youngblood - Sensor Electronics Unit

### SAREX & ARISS

- Randy Beanel, KC5YJI - School Group Mentor
- Debbie Brown, ARISS
- Linda Godwin, N5RAX - Astronaut Liaison
- Randy Hammock, KC6HUR - School Group Mentor
- Bill Hillendahl, KH6GJV - School Group Mentor
- Steve Morton, AA8HH - School Group Mentor
- Pam Mountjoy, SAREX Working Group
- Bryan Snook, KD5BXM - *Mir* & ISS Flight Qualifications
- Allan Spitzer, N3TCM - School Group Mentor
- Charlie Sufana, AJ9N - AMSAT STS-94 Mission

### Software

- Joe Holman, AD7D - Kansas City Tracker Driver
- Chris Jackson, G7UPN/ZL2TPO - WiSP
- Roy Welch, W0SL - Software Manager
- Paul Wilmott, VP9MU - Station Program

# Ariane 5, A New Success Story Begins

The European new-generation launcher Ariane 502 successfully lifted-off on October 30, 1997 from the Guiana Space Center, Europe's Space Port, in Kourou, French Guiana at 10:43 a.m.; Kourou time (13:43 UTC) seven seconds after ignition of the Vulcain engine that powers the main stage.

The two solid propellant boosters lifted the Ariane 5 launcher during the first part of the flight before separating from the main stage. The faring that shrouds the payload during ascent phase was jettisoned three minutes after lift-off. Final injection was performed by the storable propellant stage, which ignited ten minutes after lift-off.

The first flight data from the launcher are under analysis. In-depth analysis of flight data will be performed in the coming weeks at CNES, the French space agency to which ESA has delegated management of its Ariane 5 program, and by European contractors working on the program.

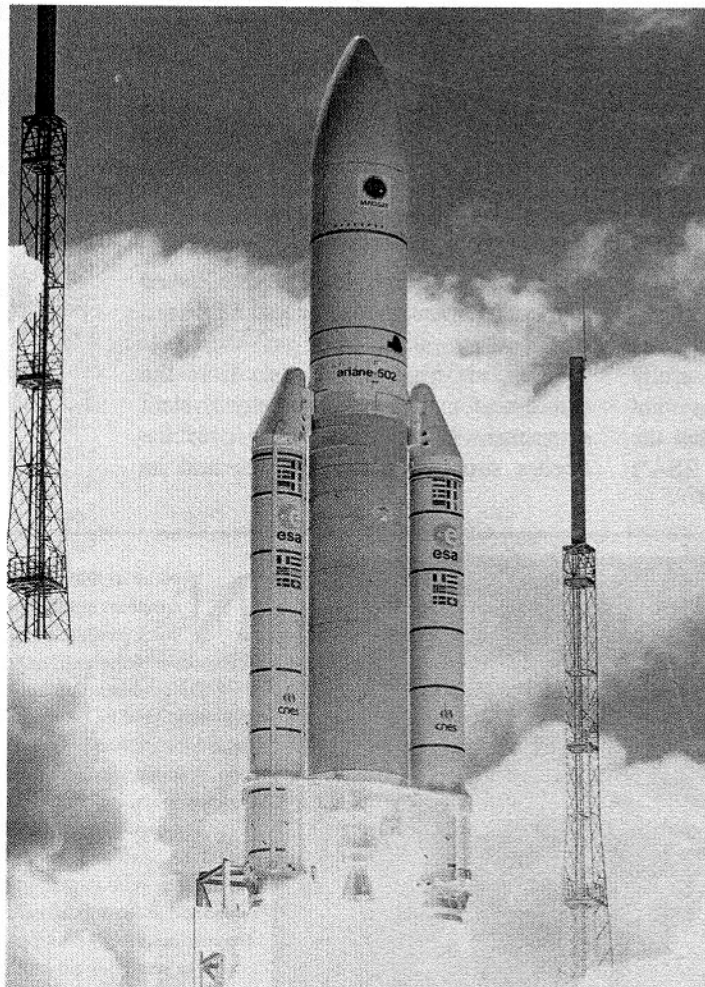
Twenty seven minutes into the flight MAQSAT H and MAQSAT B, platforms carrying instruments to analyze launcher flight behavior, and the technology satellite TEAMSAT were ejected into orbit.

"Europe is once more in Space! This is another good example of what European cooperation can do.", said ESA's Director General Antonio Rodot from the Launch Control Centre in Kourou. "All those who have consistently believed in Ariane, today have witnessed the start of a new success story. But it's only the beginning. There is still a lot of work ahead of us before this launcher can be made available to users all over the world.", added Rodot.

"We owed it to Europe and we have made it.", echoed Grard Brachet, Director General of CNES. "The teams of experts, industry and all involved in this launch in Europe and French Guiana have done a

great job. A further step towards qualification of the Ariane 5 launcher has thus been taken, Bravo!", he said.

This was the second test flight of Ariane 5 after the failure of the maiden flight on June 4, 1996. The third qualification flight, under ESA and CNES responsibility, is scheduled for spring 1998. Commercial Ariane 5 flights, managed by Arianespace, will then begin with the fourth launch in the second half of 1998.



**Successful liftoff of the Ariane-502 from the Guiana Space Center, Europe's Space Port, in Kourou, French Guiana on October 30, 1997 at 13:43 UTC. (ESA-CNES 1997)**

## Second Stage Engine Reportedly Shut Down Early

Despite the apparent successful flight of the Ariane 502, the AMSAT New Service has learned that the test may not have been a complete success. It has been reported that the second stage shut down earlier than planned causing the payloads to go into lower than expected orbits.

Data collected during the flight indicates that the liquid-fueled core vehicle of the Ariane 5 rocket rolled in flight causing its Vulcain main engine to shut down 10 to 20 seconds earlier than planned.

Therefore, the upper stage booster and attached payloads (MAQSAT H and B plus TEAMSAT) did not attain the prescribed velocity and hence went into lower orbits than expected.

In addition, ESA said that the liquid-fuel core vehicle fell to Earth 5,000 miles from its projected impact site in the Pacific Ocean. As a result, aircraft scheduled to witness the reentry were unsuccessful in reaching the area in time.

ESA officials are reported to have said that, had commercial satellites been aboard, their on-board propulsion systems would have enabled them to attain geostationary orbits, despite the lower than planned insertion. However, it has been conceded that such a correction might have resulted in a reduction in the satellites' overall life, possibly up to 10 percent.

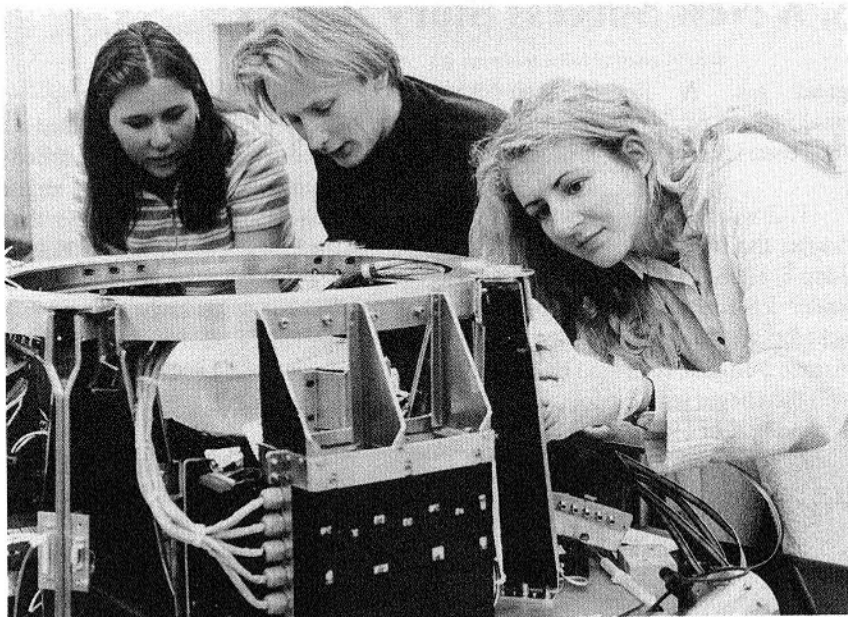
It is unclear what effect, if any, the lower orbit had on TEAMSAT; neither had its implications for Phase 3D, had it been aboard, been investigated.

A third flight test of Ariane 5 is presently scheduled for sometime next spring.

## AMSAT Congratulates ESA on Ariane-502 Test Flight

Speaking for all the AMSAT organizations of the world, Dr. Karl Meinzer DJ4ZC, President of AMSAT-DL and Phase 3-D's Project Leader, has communicated his congratulations to ESA officials on the flight of Ariane 502. He termed the test a success despite the anomaly associated with the early shutdown of the second stage engine and he expressed confidence that the cause of this difficulty will be located and corrected prior to the Ariane 503 test flight.





**TEAMSAT, a test payload for the Ariane 502 mission, is a very small and inexpensive satellite, which carries five experiments and has a mass of 302 kg. TEAMSAT was designed and built in only seven months by young graduate trainees at ESTEC, ESA's technology center in The Netherlands. (Photo ESA)**

### **TEAMSAT Announces Successful Launch**

TEAMSAT has been successfully launched on the second qualification flight of Ariane 5. Initial data showed that the satellite worked fine when ESA's

operational center (ESOC), established proper communication after a small delay.

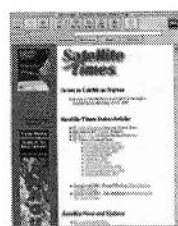
The first high quality data from the cameras of the Visual Telemetry System experiment showed clear images of the Speltra structure with the Earth and its

horizon as background. Also the images of the Autonomous Vision System camera were successfully received. Communication with the subsatellite YES, including GPS, were also successfully established.

About twenty young engineers from many European countries are staffing the Experiment Control Center was set-up at ESTEC, the technical center of ESA, using some twenty PC's with software mostly developed by the young engineers themselves.

The young engineers along with the experienced staff and technicians of ESA/ESTEC were extremely pleased after many months of intensive work designing and building TEAMSAT.

The team continued mission operations for approximately five days, which was limited to the lifetime of the on-board batteries. (via ESA Press Release and AMSAT News Service) ■



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# 38k4 Receiver Requirements

J. Paffett, C. Jackson, Z. Wahl

Surrey Satellite Technology Limited

University of Surrey, Guildford, Surrey GU2 5XH, United Kingdom

*Editor's Note: This article was originally presented at the 1998 AMSAT-UK Colloquium held in Surrey, UK from July 25-27, 1997. TMSAT-1 has been built at UoSAT in collaboration with the Thailand Micro Satellite Corporation which is a part of Mahanakorn University of Technology. Once in orbit it will offer radio amateurs an advanced Earth imaging system and high speed store and forward communications.*

With the launch of TMSAT-1, scheduled for Spring of 1998, the Radio Amateur community will be able to obtain data from one of the most advanced imaging and frequency analysis payloads available to date. The satellite's advanced imaging payload comprises three narrow-angle cameras, a wide-angle camera and a transputer, providing the ability to generate false colour satellite imagery. This increase in payload sophistication, however, has a price; that being the immense amount of data generated by the payload. A single uncompressed image is in the order of 3.3 Mbytes in size. A typical amount of data downloaded from a microsatellite in a similar environment, using the current 9600 baud scheme, is of the order of 2 Mbytes / Day. Obviously this would require an unacceptable amount of time in order to download a single image, as techniques to minimise the amount of data, and increase the rate at which the data can be downloaded have already been utilised.

The satellite uses an image compression algorithm, which reduces the size of the file by a factor of approximately 4:1, depending upon the contents of the image. This still results in a file size in the order of 800 kBytes. To be able to retrieve the image in an acceptable amount of time, the satellite's downlink modulation scheme has been modified to support a 38k4 baud (38,400 bd) data rate. Therefore, to be able to receive data from the satellite a 38k4 baud receiver and demodulator will be required.

This paper describes the requirements of the 38k4 receiver and demodulator,

describing the differences between this scheme, and the existing scheme. It is potentially viable for existing equipment to be modified in order to be able to receive the 38k4 baud data rate. This article endeavours to explain what would be required.

## The 38k4 Modulation Scheme

The 38k4 baud modulation scheme employed by TMSAT-1 is similar in principle to that of the existing UoSAT 9600 CPFSK modulation scheme used by previous UoSAT missions, which has proved extremely reliable for LEO store and forward communications [1]. The only alterations are those of the pulse shape roll-off factor, and the some of the filtering. The filtering and pulse shaping are optimised to achieve the best bit-error-rate performance, see Figure 1.

## Receiver Description

Figure 2 shows a simplified block diagram of the required receiver and demodulator. The received signal is first downconverted to a suitable intermediate frequency. At this point it is passed through a bandpass filter in order to strictly band-limit the IF chain. The intermediate frequency signal is then downconverted to a lower frequency before being filtered and

passed into the frequency discriminator. The output from the discriminator and limiter is then passed through a final filter stage before passing into the demodulator and level control.

The differences between this and the previous 9600 baud system are therefore:

- All filter bandwidths require expanding to allow for the larger bandwidth received signal.
- The crystal bandpass filter needs to have a sufficiently wide bandwidth, a minimal passband ripple, and extremely steep skirts so as to absolutely band-limit the IF chain.
- The frequency discriminator is required to be linear over its full operating range. Non-linearities will cause degradation of the received signal.

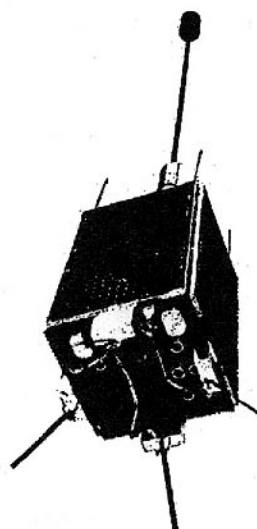
With these criteria in mind, the overall system design would appear to be straightforward, and modifications could potentially be made to an existing 9600 baud receiver and demodulator. This of course being the preferred line of action, since Doppler tracking and receiver control may have already been carried out for 9600 baud operation, and could therefore still be used.

## TMSAT-1 Facts and Figures

|                     |                        |
|---------------------|------------------------|
| Rx0                 | Command uplink only    |
| Rx1                 | 145.925 / 145.975 MHz  |
| Rx2                 | 145.975 / 145.925 MHz  |
| Uplink Modulation   | 9600bd FSK             |
| Downlink Frequency  | 436.925 MHz            |
| Downlink Power      | Variable 1 to 10 Watts |
| Downlink Modulation | 9600bd FSK             |
|                     | 38400bd FSK            |
| Broadcast Callsign  | TMSAT1-11              |
| BBS Callsign        | TMSAT1-12              |

## Proposed Orbit

|                |                 |
|----------------|-----------------|
| Inclination    | 98.75 degrees   |
|                | Sun Synchronous |
| Orbital Period | 101. minutes    |
| Altitude       | 821 km          |



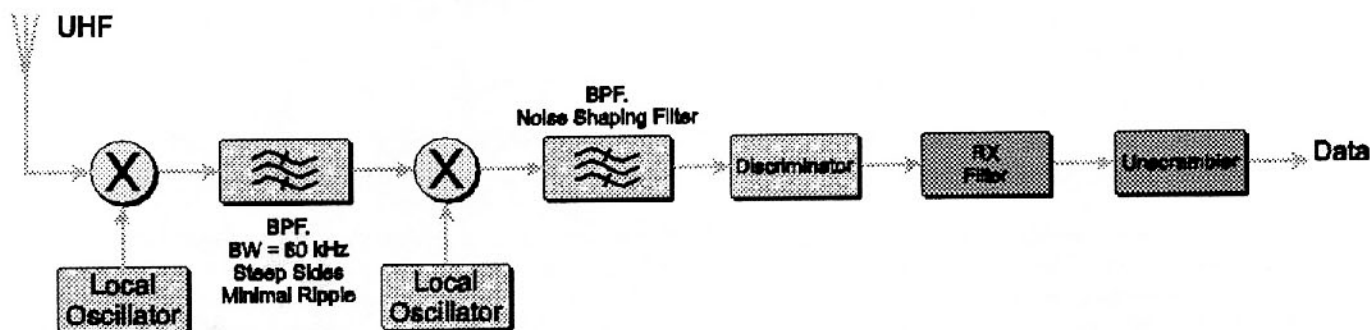


Figure 2. 38k4 Receiver Block Diagram

The problem arises when one examines the specification of the bandpass band-limiting filter required. The filter selected for the SSTL groundstation is an 8-pole Butterworth crystal filter, with a centre frequency of 21.4 MHz, BW@-3dB = 65 kHz, extremely steep skirts, and minimal passband ripple. Such a filter plot is shown in Figure 3.

These are available commercially from Solent Electronic Service, but cost approximately £240.00. Although other possible solutions exist the specification of the filter is the minimum required for acceptable performance of the 38k4 receiver. A compromise in the specifications would ultimately lead to a degraded performance.

### SSTL 38k4 Receiver Design

The SSTL 38k4 receiver comprises of the following elements:

- Wood & Douglas WD1143 Narrow Band UHF Receiver (Modified).
- G3RUH "Miller" 9600 Baud FSK Modem (Modified).
- GS2003A SSTL Modem Interface Card.

### Wood & Douglas Receiver

The WD1143/001 is a narrow-band frequency-modulation UHF (400-440 MHz) receiver with 25 kHz channel spacing. The receiver has facilities for four operational channels, each with automatic frequency control to ensure optimum centralisation of the receiver signal within the receiver passband. The receiver is a triple-conversion design to ensure high image rejection with good adjacent channel rejection.

The UHF input signal is amplified by two high-gain, low-noise rf stages of amplification prior to injection into the first

of three mixers. The local oscillator frequencies for the 1st and 2nd mixer are derived from the same fundamental frequency. The 1st local oscillator has a frequency 4x the fundamental and the 2nd 24x the fundamental. The output of the 2nd mixer is at an intermediate frequency of 21.4 MHz and is subsequently filtered by a bandpass filter. The filter comprises two separate bandpass filters in cascade. The first is a 21.4 MHz, 8-pole Butterworth crystal filter with a -3dB bandwidth of 65 kHz which is used to absolutely band-limit the intermediate frequency chain. The second filter is a simple 2-pole LC filter which is "quasi-Gaussian" in voltage response, with a -3dB bandwidth of 38.4 kHz.

The third and final intermediate frequency is produced by a multi-function intermediate frequency processor device with an on-board oscillator running at 20.945 MHz, producing the 455 kHz 3rd

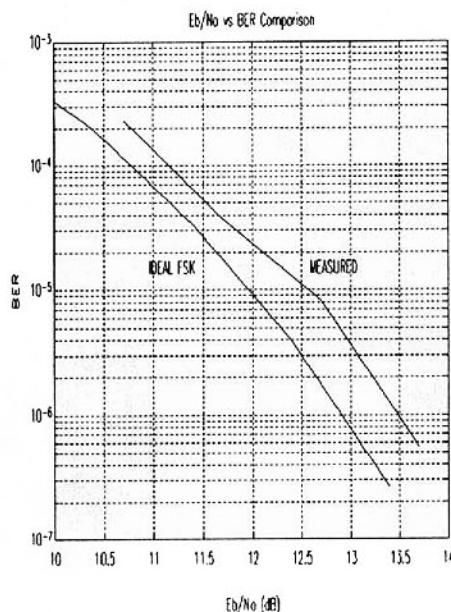


Figure 1. Bit Error Rate Performance.

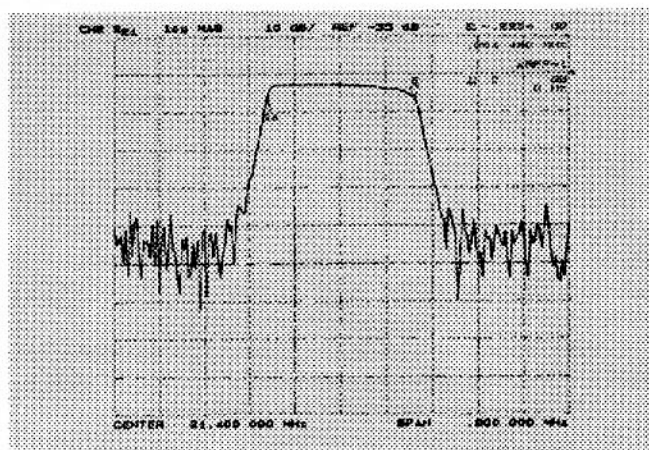


Figure 3. Filter Characteristics



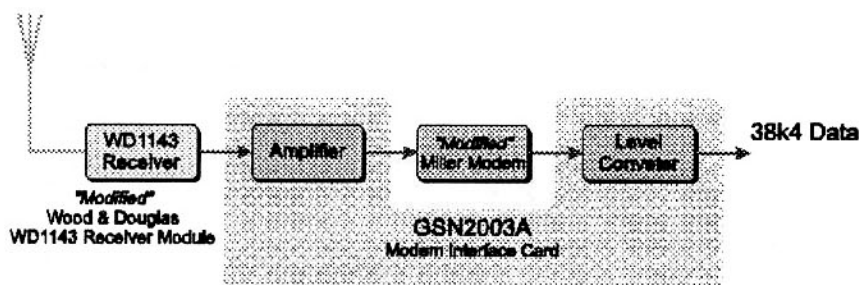


Figure 4. SSTL 38K4 Receiver Components

intermediate frequency. The discriminator has been set to have a relatively low Q, to ensure a low distortion "linear" discriminator characteristic. The receiver pre-discriminator filtering is based upon the results of Tjhung & Wittke [2]. Their results for optimum bit-error-rate using NRZ binary FSK indicate that the optimum performance could be obtained with a pre-discriminator BT product of 1.0, that is the filter's bandwidth should be 38.4 kHz.

Although the modulation scheme used by Tjhung & Wittke is not the same as the UoSAT shaped-raised-cosine system, the relative spectral densities are similar.

Only the demodulator circuitry is required, and modifications are required to the receive filter and the output DAC circuitry with the latter preceded by the receiver clock recovery. The received audio is fed into the receiver filter straight from the WD1143 via a small amplification stage. The signal is filtered, unscrambled and is then passed onto the SSTL modem interface card for level shifting.

## Conclusions

Whilst the change from the existing 9600 baud data-rate to the new 38k4 data-rate will initially pose a problem, the implementation of such a receiver will provide a reward in terms of access to the new images and faster store and forward communications.

There are various ways in which the receiver could be implemented, from the modification of existing equipment through to the design and construction of a standalone unit. Currently no off-the-shelf solutions exist. The implementation of the receiver, therefore, provides an excellent technical challenge.

## Acknowledgements

The authors would like to acknowledge the support provided by the Engineering and Physical Science Research Council, the Centre for Satellite Engineering Research and particularly Surrey Satellite Technology Limited.

## References

1. J. Miller, "9600 Baud Packet Radio Modem Design", ARRL 7th Computer Network Conference, August 16, 1988, page 136.
2. T. Tjhung and P. Wittke, "Carrier Transmission of Binary Data in a Restricted Band", IEEE Transactions on Communications, Volt COM-18, No. 4, August 1970, page 295.
3. Zeno Wahl, "38.4 kb/s FSK Modem System", Internal SSTL Document, March 1993.

## Purchase Details

### Narrow Band UHF Receiver

Wood & Douglas WD1143/001 Receiver.  
From : WOOD & DOUGLAS  
Telephone : (01734) 811444  
Approximate Cost : £305.00  
Delivery : 4-5 Weeks

### 8-Pole Butterworth Crystal Filter

21.4 MHz BW=65 kHz Filter.  
From : Solent Electronic Services  
Telephone : (01703) 456074  
Approximate Cost : £240.00  
Delivery : 6-8 Weeks ■

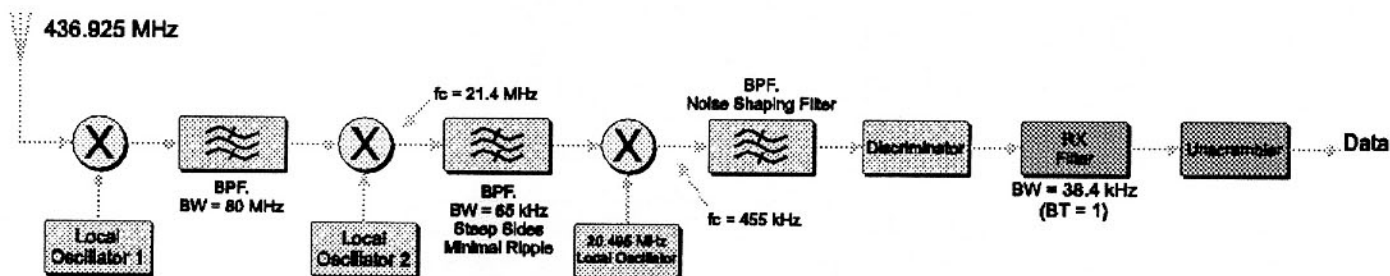


Figure 5.

# KIØAG Micro-Duplexer

## Chuck Duey, KIØAG, [ki0ag@amsat.org](mailto:ki0ag@amsat.org)

A good duplexer can make the difference between hearing AO-27 full quieting and hearing a bunch of muffled static. The main purpose of a duplexer is to separate the transmit and receive signals. In the case of an HT working AO-27 the duplexer separates the signals for the 70 centimeter downlink and the 2 meter uplink. Depending on the type of feed, a 70 centimeter antenna can look like an open or a short at 2 meters. Similarly at 70 centimeters the 2 meter antenna will not have a 50 ohm impedance. The problem is to combine the 70 centimeter antenna and the 2 meter antenna so that they do not interfere with each other's signal or loading. One solution to the problem is using a duplexer which decouples the receive antenna from the transmit antenna.

Duplexers come in many models that can handle over 100 watts. This power handling capability intended for repeaters is more than what is needed for an HT. A large duplexer would be very inconvenient working an AO-27 pass while aiming the antenna by hand.

A duplexer for 2 meters and 70 centimeters is quite simple in theory, but attaining low loss can be a challenge. A simple duplexer would employ a low pass

filter from the radio to the 2 meter antenna and a high pass filter from the radio to the 70 centimeter antenna. If the filters have low insertion loss and the board layout is very clean; wam!, bam!, instant duplexer. Unfortunately it isn't usually that easy.

To start down the right path, look up a good filter in an analog filter book. My favorite is the venerable: *Handbook of Filter Synthesis* by Anatol Zverev. A good filter should have a steep cutoff and not too much ripple across the passband. Many of the Chebyshev filters fit this requirement. The only problem is most books give numbers for a filter scaled to 'Omega = 1' or about 1/6 Hz. The values are in Farads and Henrys, a little big to fit in the boom of your antenna. Also the impedance is at 1 Ohm. At 1 Ohm the VSWR would be a bit large. So, the filter must be scaled. Here is an example:

Chebyshev n = 5 Ripple = 0.5dB  
 $R_s = 1 \text{ Ohm}$ ,  $L_1 = 1.8068$ ,  $C_1 = 1.3025$ ,  
 $L_2 = 2.6914$ ,  $C_2 = 1.3025$ ,  $L_3 = 1.8068$   
 (From Reference 1).

To scale Inductance:  
 $L_{\text{new}} = L_{\text{old}} * R_{s_{\text{new}}} / (2 * \pi * \text{Hz})$

To scale Capacitance:  
 $C_{\text{new}} = C_{\text{old}} / (R_{s_{\text{new}}} * 2 * \pi * \text{Hz})$

Where Hz = new cutoff frequency (220 MHz).

$R_{s_{\text{new}}} = \text{new filter impedance (50 } \Omega)$   
 $\pi = 3.14159...$

After scaling, the filter becomes:  
 $L_1 = 65\text{nH}$ ,  $C_1 = 18.8\text{pF}$ ,  $L_2 = 97.3\text{nH}$ ,  
 $C_2 = 18.8\text{pF}$ ,  $L_3 = 65\text{nH}$ .

Due to the cost of custom components, it is best to round the values to the closest standard value.

This should be done within reason. Adjusting the cutoff frequency a bit to get closer values can be done with a spreadsheet. After looking at the standard values, the filter becomes:

$L_1 = 68\text{nH}$ ,  $C_1 = 18\text{pF}$ ,  $L_2 = 100\text{nH}$ ,  
 $C_2 = 18\text{pF}$ , and  $L_3 = 68\text{nH}$ .

If a SPICE program is available, a careful look at the calculated values is always a good idea. Moving the filter cutoff around to give the lowest losses is also helpful. By choosing the ripples in the Chebyshev filter to correspond with the 2 meter and 70 centimeter frequencies, the losses and rejection can be optimized.

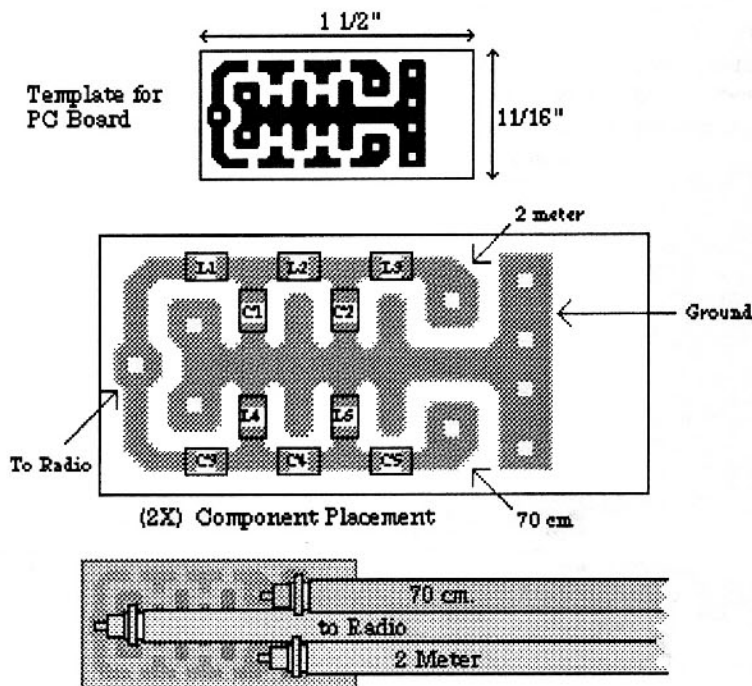


Figure 1: Duplexer board Layout

That takes care of the low pass side of the duplexer, but what about the high pass side? Second verse same as the first, just flip it over. This means take the reciprocal of all the values in the table and change the capacitors to Inductors and visa versa:

I.E.  $C_{\text{highpass}} = 1/L_{\text{lowpass}}$  and  $L_{\text{highpass}} = 1/C_{\text{lowpass}}$ .

The un-scaled filter becomes:  
 $C1 = 0.5535$ ,  $L1 = 0.7678$ ,  $C2 = 0.3716$ ,  
 $L2 = 0.7678$ ,  $C3 = 0.5535$ .

Now apply the same formulas as above at 50  $\Omega$  and 380 MHz.

$C1 = 4.6\text{pF}$   $L1 = 16\text{nH}$ ,  $C2 = 3.1\text{pF}$ ,  
 $L2 = 16\text{nH}$ ,  $C3 = 4.6\text{pF}$ .

With Standard Values:  $C1 = 4.7\text{pF}$   
 $L1 = 15\text{nH}$ ,  $C2 = 2.7\text{pF}$ ,  $L2 = 15\text{nH}$ ,  
 $C3 = 4.7\text{pF}$ .

After calculating component values the most difficult part starts - construction. At 437 MHz the best rules are to keep the signal route as short as possible, and keep the grounds as low impedance as possible. The other thing to keep in mind is the physical size of the components. Thanks to the Telecom Industry, there are many small RF components that can help keep everything nice and small. Because the circuit is small, it was designed to fit inside the boom of a Yagi. After a few trial runs and quite a few AO-27 passes a PC board was designed (Figure 1):

For this design  $C1$ ,  $C2 = 18\text{pF}$   $C3$ ,  
 $C5 = 4.7\text{pF}$ ,  $C4 = 3.0\text{pF}$   $L1$ ,  $L3 = 68\text{nH}$ ,  
 $L2 = 100\text{nH}$  and  $L4$ ,  $L5 = 15\text{nH}$ .

The voltage rating of the capacitors and the current rating of the inductors determines the power the duplexer can handle. If the VSWR = 1.0, the currents and voltages are easier to calculate.:

$$V = \text{SQRT}(P \cdot R), \text{ and } I = \text{SQRT}(P/R)$$

At 50 Ohms and 10 Watts:  $V = 22$  Volts and  $I = 0.45$  Amps. This means the inductors in the Low Pass section must be able to handle over 450 mA and the capacitors in the High Pass section must be rated at 22 Volts or better. Most surface mount capacitors in the low pF range are 50 Volts, so they present no problem. However, there are many inductors that are

250 mA or less. For a good margin add ~50% to the current rating so look for 650 mA or better. With the power ratings in mind the Parts list becomes:

#### Parts List:

- 2 - 4.7 pF 5% 50V NPO 1206 or 0805
- 1 - 3.0 pF 5% 50V NPO 1206 or 0805
- 2 - 17 pF 5% 50V NPO 1206 or 0805
- 2 - 15 nH 5% 650 mA 1008
- 2 - 68 nH 5% 650 mA 1008 or 1210
- 1 - 100 nH 5% 650 mA 1008 or 1210

Soldering the components can be tricky. Use a low wattage iron and metallic tweezers. Do not force the components around, or else the end caps will break off. For the novice with surface mount parts it is best to apply some solder to one pad on the board. Take the component with the tweezers and place it in the correct location while heating the pad with solder. After the component is in place solder the other side. Take a look through a magnifying glass to check the work. The solder between the component lead and the board pad should look smooth and shiny. For inductors a quick continuity check helps spot some bad joints.

After all the surface mount components are on, it's time to add the cables. Strip back the center conductor 1/2 inch, and the shield 1/4 inch. Bend the center conductor 90 degrees down about 1/4 inch out. Put the center conductor through the hole from the side without components and solder. Then using 3/4 inch of wire, loop it over the shield and pull it tight, and solder to the board and the shield. After the cables are on,

check things out with a dummy load and a SWR meter.

Once everything is assembled and tested, it is time to put on the finishing touches. First, check the fit of the duplexer. For the square boom of an Arrow antenna, make sure the components and cables do not bind up. Sometimes quick adjustment to the board with a file makes a good fit. Be careful not to file the components. Some heat shrink tubing or electrical tape over the duplexer board and cables should prevent any shorts and protect from damage.

This duplexer has reduced the weight, and the number of cables for my AO-27 setup. I have used it to work many passes from a wide range of locations and conditions. I hope it works as well for all who try building this project as it has worked for me.

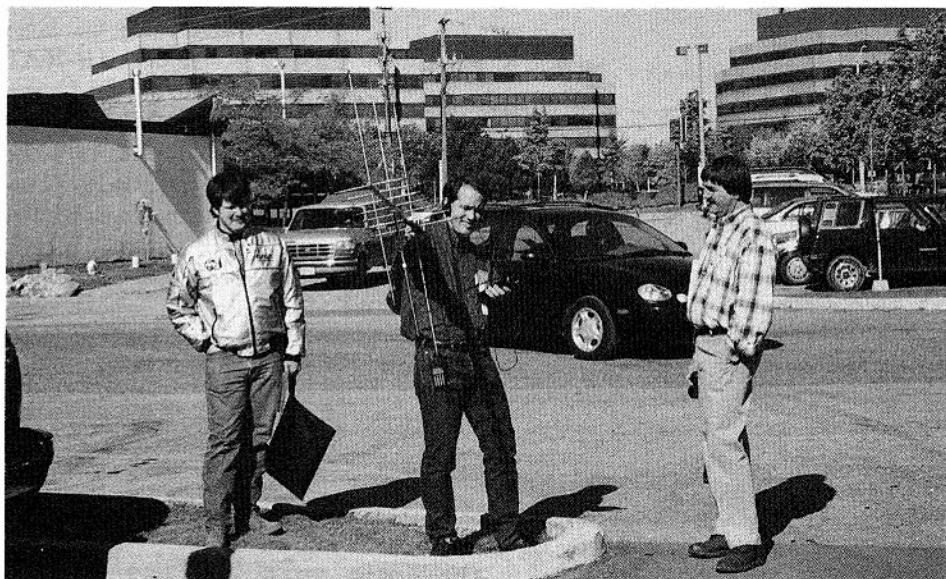
73 and Catch Ya' on the Birds!  
 Chuck Duey, K1OAG

#### Reference

1. Handbook of Filter Synthesis, Anatol I. Zverev. John Wiley & Sons, 1967.

#### Suppliers

- Digi-Key 1-800-DIGIKEY  
Delevan Inductors, and Panasonic Caps.
- Far Circuits 1-847-426-2431  
PC board for the Micro-Duplexer.
- Arrow Antenna 1-307-638-2369  
Fully assembled and tested Micro-Duplexers and Dual band Yagi's.



K1OAG demonstrating his micro-duplexer during an AO-27 pass at the AMSAT-NA Space Symposium and Meeting, Toronto, Canada. (KC5JVB photo)



# AO-27 from England and Scotland with an FT-50R and Whip Antenna

Ray Soifer, W2RS

[w2rs@amsat.org](mailto:w2rs@amsat.org)

I had been looking for a small, dual-band handheld that covers the European 70cm band of 430-440 MHz as well as the US FM sub-band of 440-450 MHz, so when I saw a good sale on a Yaesu FT-50R, I could not resist.

The radio arrived just in time to take with me on an extended business trip, during which I had an idea; why not try to hear AO-27? The results of my listening, however, were disappointing; the little seven-inch *rubber duck* antenna that comes with the radio, while quite satisfactory for operation through nearby terrestrial repeaters, just wasn't up to the job of hearing a satellite 500 miles out in space.

When I got home, I tried listening for AO-27 with a half-wave whip instead of the *rubber duck*, and the difference was night

from day. I could now hear the satellite well for up to eight to ten minutes per pass. In fact, I could hear it much better with the FT-50R and half-wave whip than with the *high-gain* dual-band mobile antenna on my car, or any other antenna I tried other than a beam with azimuth and elevation control.

That should not be too surprising. A half-wave whip, mounted on a hand-held receiver, is a very good antenna for satellite operation. Unlike a 5/8-wave whip, it does not depend upon the existence of a ground plane. There's no coax loss to worry about as not only the RF amplifier, but your entire receiver is already mounted at the antenna! I have saved the most important advantage for last: with a handheld radio, you can move the whip antenna around as much as you want to match the direction and polarization of the incoming signal. *Armstrong X, Y and Z-axis rotation!*

That solved my reception problem, but a half-wave whip at 436 MHz makes a poor transmitting antenna for 145 MHz. So, for transmitting, I tried another experiment: using the FT-50R and half-wave whip for reception, I uplinked to AO-27 on 145.850 MHz using the same Kenwood TH-26AT and half-wave two-meter whip which I had used to work through RS-10. (Two HTs, one in each hand — now that's *two-fisted operating*.) Lo and behold: with my two watts output, I worked three stations on a single pass; B.J. Arts, WTON, Minnesota; John O'Hara, KB8TJX, Ohio; and Dave Baldwin, KE4MDQ, South Carolina!

That did it; I was hooked. I started looking through the catalogs for a single whip antenna that would work for both uplinking and downlinking to AO-27 through the FT-50R. The one I settled on, the MFJ-1717, is a light, flexible 16-inch rubber-coated whip that operates as a half-wave at 70 cm and a quarter-wave at 2 meters (for use with the FT-50R, the Yaesu CN-3 BNC-to-SMA adapter is also required).

A quarter-wave antenna for transmitting would not be as effective as the two-meter half-wave, but any dual-band antenna is inevitably a compromise. My doubts about the MFJ-1717, however, were quickly resolved: as soon as I installed it, I quickly worked three more stations through AO-27, transmitting and receiving on the FT-50R with 2 watts EIRP: Ben Sylvestre, VE2VB in Quebec; Roger Snyder, K4RS in Florida and and MikeFunaro, N0XD in Iowa.

Shortly thereafter, I took off again for two weeks in the United Kingdom, beginning with the annual AMSAT-UK Colloquium. Naturally, the FT-50R and MFJ-1717 were among the first items I packed.

Once at the Colloquium, in a fit of enthusiasm I announced to the assembled delegates that I would demonstrate my AO-27 *micro-station* just before noon on Sunday, outside the auditorium, when AO-27 was due to pass nearly overhead. We trooped outside at the appointed time, and heard AO-27 coming in loud and clear, but then reality set in: the QRM level over Europe on AO-27's single repeater channel was much heavier than in North America, so heavy, in fact — stations were three or four deep throughout the pass — that I was unable to make any QSOs at all (since this was all on the spur of the moment, I hadn't thought to make any schedules in advance). Many of those watching were impressed by the reception, or so they told me (they were being polite), but I was crushed!

The Colloquium ended that night, and my itinerary from there called for a week of R&R in the north of Scotland (away from



Ray Soifer, W2RS shown operating the AO-27 *micro-station* from the same site (overlooking Norwich, England) from which he had worked G3IOR on RS-10 (see article in the March/April 1997 issue of *The AMSAT Journal*). (Photo by Pat Gowen, G3IOR)

phones and fax machines), followed by a week of business in central London. The weekend in between would be spent with my old friends Pat Gowen, G3IOR and Norma Gowen, in the East Anglian town of Norwich, with whom I have frequently stayed when I had free time in the U.K. I departed for Inverness on Monday morning, wondering if I would really be able to work anyone while there or if the European QRM level would win out in the end.

My first stop after arriving in Scotland, actually only a few miles from the Inverness airport, was the historic battlefield of Culloden, where the last major battle between Scottish and English forces took place in 1746. It is a rather extensive site, which takes at least several hours to roam around and take in.

The first AO-27 pass of the day came up while I was walking around the field, observing the positions taken by the various military units more than 250 years ago. I screwed the whip onto the FT-50R, turned it on, and heard several Europeans including a German station, DG0JS, who was calling a friend of his, apparently on schedule. The friend did not answer, so I called DG0JS myself. After three or four tries, success: my first AO-27 QSO from outside the United States!

I wound up working five stations from Scotland via AO-27. In addition to DG0JS from Culloden, Tony, G7OEM was worked from John o'Groats (in the rare grid square of IO88) and three stations, F6BYJ, F1BAV and DG6OBP, from the shores of Loch Ness where Nessie must have had fun watching me.

The following weekend, while touring around with Pat and Norma Gowen, we worked Bob, G8ATE via AO-27 from the little farming village of Cockfield, Suffolk, about four miles north of Lavenham. Before heading back to London, I made a schedule with Pat for the following day, and sure enough, when I went out to St. James's Park to get away from buildings and listen for AO-27, we had a solid two-minute QSO with full-quieting signals at times.

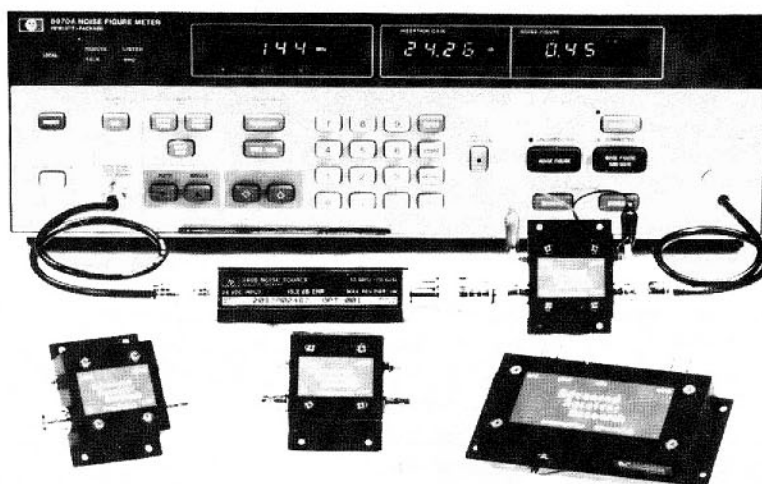
Also from St. James's Park I worked another old friend, Ib Christoffersen, OZ1MY in Denmark, who heard my CQ AO-27 and surprised me by coming back (DG6OBP and G8ATE had also come back

to my CQs). That made eight AO-27 QSOs in all on that trip. I probably could have made more QSOs from London if the intermod from commercial stations hadn't been so bad, but that's another story.

I've since made many additional QSOs, mostly from my back yard in New Jersey. Also, at the AMSAT-NA

Symposium in Toronto, I worked five stations on a single pass. Perhaps the most fun I had, though, besides those first QSOs, was with the airport security officer at Heathrow who noticed the little FT-50R in my bag and asked, "What's that? A cellular phone?" "No," I replied, as poker-faced as I could manage, "it's a satellite communications terminal!" ■

## High Performance vhf/uhf preamps



| Receive Only | Freq. Range (MHz) | N.F. (dB) | Gain (dB) | 1 dB Comp. (dBm) | Device Type | Price   |
|--------------|-------------------|-----------|-----------|------------------|-------------|---------|
| P28VD        | 28-30             | < 1.1     | 15        | 0                | DGFET       | \$29.95 |
| P50VD        | 50-54             | < 1.3     | 15        | 0                | DGFET       | \$29.95 |
| P50VDG       | 50-54             | < 0.5     | 24        | +12              | GaAsFET     | \$79.95 |
| P144VD       | 144-148           | < 1.5     | 15        | 0                | DGFET       | \$29.95 |
| P144VDA      | 144-148           | < 1.0     | 15        | 0                | DGFET       | \$37.95 |
| P144VDG      | 144-148           | < 0.5     | 24        | +12              | GaAsFET     | \$79.95 |
| P220VD       | 220-225           | < 1.8     | 15        | 0                | DGFET       | \$29.95 |
| P220VDA      | 220-225           | < 1.2     | 15        | 0                | DGFET       | \$37.95 |
| P220VDG      | 220-225           | < 0.5     | 20        | +12              | GaAsFET     | \$79.95 |
| P432VD       | 420-450           | < 1.8     | 15        | -20              | Bipolar     | \$32.95 |
| P432VDA      | 420-450           | < 1.1     | 17        | -20              | Bipolar     | \$49.95 |
| P432VDG      | 420-450           | < 0.5     | 16        | +12              | GaAsFET     | \$79.95 |

### Inline (rf switched)

|          |         |        |    |     |         |          |
|----------|---------|--------|----|-----|---------|----------|
| SP28VD   | 28-30   | < 1.2  | 15 | 0   | DGFET   | \$59.95  |
| SP50VD   | 50-54   | < 1.4  | 15 | 0   | DGFET   | \$59.95  |
| SP50VDG  | 50-54   | < 0.55 | 24 | +12 | GaAsFET | \$109.95 |
| SP144VD  | 144-148 | < 1.6  | 15 | 0   | DGFET   | \$59.95  |
| SP144VDA | 144-148 | < 1.1  | 15 | 0   | DGFET   | \$67.95  |
| SP144VDG | 144-148 | < 0.55 | 24 | +12 | GaAsFET | \$109.95 |
| SP220VD  | 220-225 | < 1.9  | 15 | 0   | DGFET   | \$59.95  |
| SP220VDA | 220-225 | < 1.3  | 15 | 0   | DGFET   | \$67.95  |
| SP220VDG | 220-225 | < 0.55 | 20 | +12 | GaAsFET | \$109.95 |
| SP432VD  | 420-450 | < 1.9  | 15 | -20 | Bipolar | \$62.95  |
| SP432VDA | 420-450 | < 1.2  | 17 | -20 | Bipolar | \$79.95  |
| SP432VDG | 420-450 | < 0.55 | 16 | +12 | GaAsFET | \$109.95 |

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## Field Ops Update: Area Coordinator Success Stories

Barry A. Baines, WD4ASW

[wd4asw@amsat.org](mailto:wd4asw@amsat.org)

One of the reasons why I enjoy the AMSAT Symposium so much is the opportunity to meet with our Area Coordinators at our Field Ops Breakfast on Sunday morning. Our annual gathering provides a great opportunity to review our Field Ops Team accomplishments, exchange ideas on how to represent AMSAT more effectively on the local level, and cover any concerns that our area coordinators may have. About 25-30 folks attend the breakfast each year, and I am always impressed by the enthusiasm and imagination of our volunteers. Their successes encourage all of us to expand our efforts to represent AMSAT as our time allows. Thanks to Robin Haighton, VE3FRH, the Delta Hotel staff made available a suitable meeting area for our group in a portion of their restaurant during this year's Annual Symposium at Toronto.

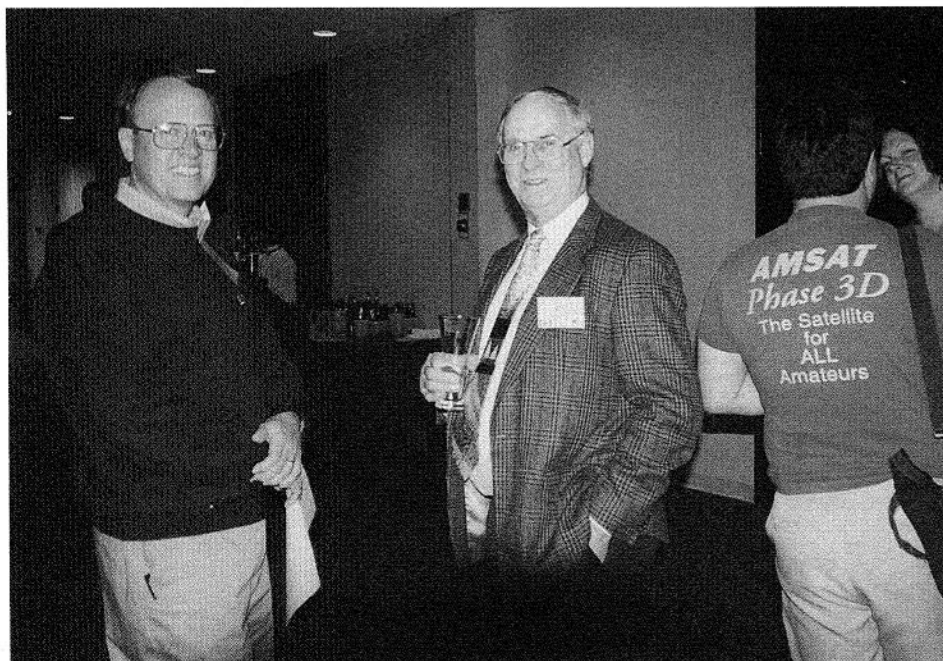
This year, for example, George Caswell, W1ME, and Mike Rudzki, N8MR, talked about their experiences with AMSAT nets on their local repeater systems. George highlighted the successes in Northern New England in utilizing the Houston AMSAT net feed while Mike explained how the AMSAT net was established in Southern Michigan. We also talked about making club presentations,

where to find presentation materials on the AMSAT web site, and the continuing development of Satellite Workshops. There were three Satellite Workshops given in 1997 (at Miami, FL; Seaside, OR; and Riverside, CA) and we expect to conduct additional workshops in 1998, starting with the Orlando Hamcation on Friday, February 13. There was a good discussion about utilizing AO-27 as a demonstration satellite at hamfests, using HTs and handheld Yagi antennas to encourage newcomers to become involved with amateur radio satellites.

Our annual Symposium also provides an opportunity to recognize outstanding individuals who have contributed to AMSAT's success by volunteering their time, talent, and energy. During the Annual Banquet in Toronto this year, the Field Ops Team recognized six Area Coordinators for their contributions:

- Terry Douds, WB8CKI, of Lancaster, OH is recognized for his significant support to AMSAT in producing video documentation of Phase 3D's construction as well as his role in AMSAT's presence at the 1997 Dayton Hamvention.

- Dee Interdonato, NB2F, of Lodi, NJ is recognized for his many years of dedicated service as an Area Coordinator in the New Jersey area and his outstanding success as a local liaison for AMSAT.
- Ed Krome, K9EK, of Columbus, IN served as team leader for the AMSAT/ARRL Satellite Workshop this past June in Seaside, OR and made satellite presentations to over 125 attendees. Ed also contributed greatly to AMSAT by his presentation materials on how to build satellite stations in the microwave bands.
- Roger Ley, WA9PZL, of Bossier City, LA has served as a dedicated AMSAT Area Coordinator over the years, conducting a wide-area AMSAT net in Arkansas, Louisiana, and Texas. He also set up a digital station to demonstrate amateur satellite operations at the 1997 Central States VHF Conference.
- Gerald Schmitt, KK5YY, of Los Alamos, NM is a pioneer and strong advocate of showing the relative ease of using amateur radio satellites by actively demonstrating AO-27 with a handi-talkie and hand held crossed Yagi antenna during a number of conventions around the country. He gave demonstrations in New Mexico, Arizona, California, Texas, as well as the 1997 ARRL National Convention in Jacksonville, FL. By his enthusiasm, he has motivated a number of individuals to try amateur satellite operation.
- Jerry Smyth, N8ULU, of Dearborn, MI is a pioneer in developing new ways to demonstrate amateur satellites in his community, including the construction of an analog satellite gateway which allows amateurs to operate through an amateur satellite by means of a local repeater using a



Members enjoying the Magnetorquing Hour prior to the AMSAT-NA Banquet in Toronto.  
(Photo by Craig Mellinger, N2MNA)

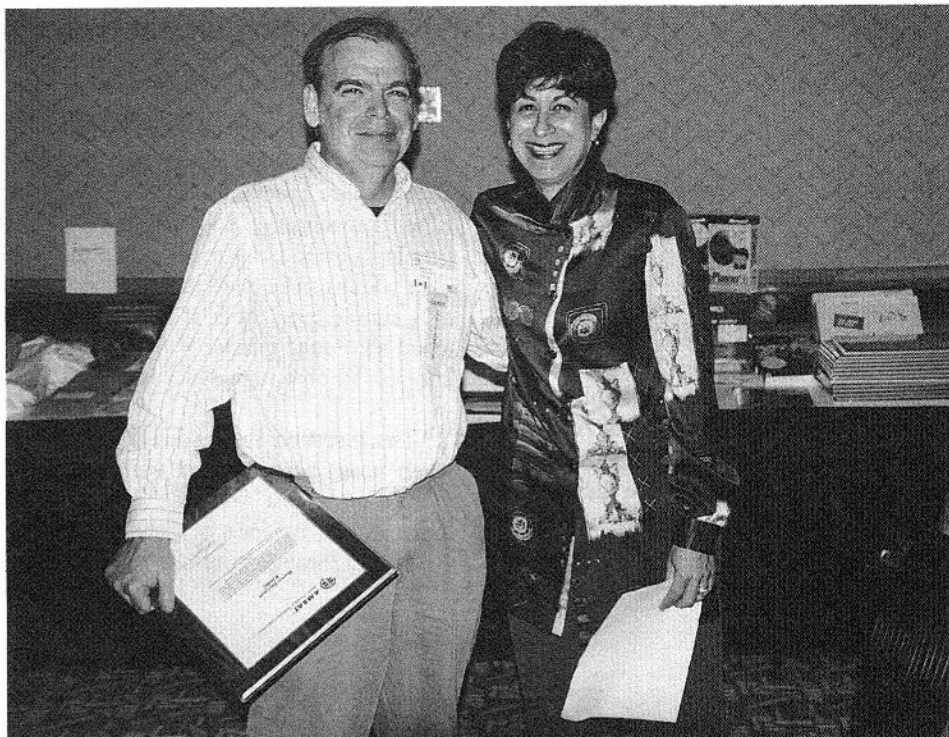


handheld. He has established AMSAT nets in Michigan and represented AMSAT at hamfests that are outside his local area. An avid AO-27 user, he has effectively used that medium to demonstrate to newcomers the relative ease of entering the satellite hobby.

- Howard Ziserman, WA3GOV, of Owings Mills, MD has been called the *Iron Man* of Field Ops as there is no one who handles more hamfests or makes more presentations than he. His willingness to volunteer to handle hamfests in Pennsylvania, Maryland, Delaware, and Virginia, sometimes driving hundreds of miles, is most appreciated. Howard also has served as a volunteer at the AMSAT office in Silver Spring.
- Paul Beckman, WA0RSE of Mendota Heights, MN is recognized for his compilation of the *Provisional Preliminary Pre-flight Guide to Phase 3D*, a compendium of materials pertaining to Amateur Radio's biggest satellite project. The book was first released at the 1997 Dayton Hamvention and was a tremendous success, creating the most comprehensive book yet on Phase 3D and making it available as a significant fund raising vehicle.

AMSAT is certainly indebted to these individuals for their significant contributions to our organization. By recognizing their accomplishments, we celebrate the successes that the entire Field Ops Team has enjoyed this year. By acknowledging these volunteers, however, we do not want to overlook the fact that there are many other outstanding volunteers whose achievements haven't been singled out. Our continued growth and support of AMSAT is dependent upon everyone's contribution.

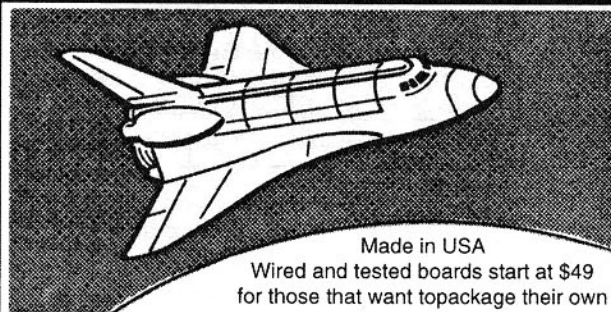
If you are interested in helping represent AMSAT in your community, please contact me at [wd4asw@amsat.org](mailto:wd4asw@amsat.org) or call 904-398-5185. We are always looking for additional support. ■



Martin Davidoff, K2UBC and Martha Saragovitz, AMSAT-NA Corporate Secretary at the AMSAT Banquet in Toronto. Martin is the author of *The Satellite Experimenter's Handbook*. (Photo by Craig Mellinger, N2MNA)

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# A Stripline Filter for the Mode-J Operator

John A. Hackett, LA2QAA

Depending on the type of antennas used...one of the problems the newcomer to mode-J operating often experiences is third harmonic break-in on the 70cm receiver...caused by poor filtering in the 2m transmitter.

A simple cure for this problem is a quarter wave high-quality 2m stripline filter between the 2m rig's output and the antenna. In extreme cases a 70cm filter can be inserted in the line between the antenna and 70cm rig. However, this is usually not necessary.

There are many designs for high-Q filters....i.e. resonant cavity etc...but they often require special tools and access to a lathe for machining. Shown as Figure 1 is a simple-to-build but effective stripline type filter which can be made in a weekend using only simple hand tools. It is a capacitively tuned shortened quarter wave stripline for 2m with 50 ohm impedance in and out.

The insertion loss is less than 0.8 dB when tuned properly and will cure most mode-J problems with the exception of those caused by irate neighbors throwing wallbricks through your bay window.

## Items Required:

- 2 BNC connectors
- 2 Vertical piston trimmers....(Erie types used at LA2QAA)
- 2 18mm brass or copper discs
- 2 Strips of brass...84mm x 4mm x 1mm
- 1 Brass or copper tube...10mm x 319mm
- 1 Piece of plexiglass...50 x 25mm
- 1 50 x 4mm brass bolt
- 2 4mm brass nuts....(one soldered to the end of the enclosure and one used as a lock-nut

The enclosures are made from single sided printed circuit board material:

- 2 355 x 25mm
- 2 355 x 50mm
- 2 50 x 25mm
- 4 35 x 4mm nuts and bolts

Scrutiny of the diagram should ensure things *come together* in the correct order but...just in case....

Start by soldering the two sides and base together. Small blocks of 46mm x 25mm wood used as *spacers* will ensure the work doesn't *bend-in* while soldering the seams....point solder first, then when you're satisfied, with the *product* draw a *hot* iron along the seam.

Next...lay one of the end pieces on a flat surface...tin it with solder...likewise tin the end of the brass tube. Then hold it vertically and solder it to the end piece making sure it is perpendicular. Tack solder first; then when you're satisfied solder the seam all the way round. I used a chisel bit in a 75 watt iron for this job. While that end cools...bore a hole in the other end-plate just slightly smaller than the diameter of the brass nut. Using a needle file...file out an aperture for the nut making sure it's a tight fit in the hole. Insert the nut then solder the seam. Now cut a piece of Plexiglass 50 x 25 mm and bore a hole in the center for the brass tube. The plexiglass serves to keep the tube rigid and centered along the cavity.

After placing the plexiglass on the tube you may now solder one of the brass discs to the end. This forms the stator plate of the end capacitor. After that has cooled you

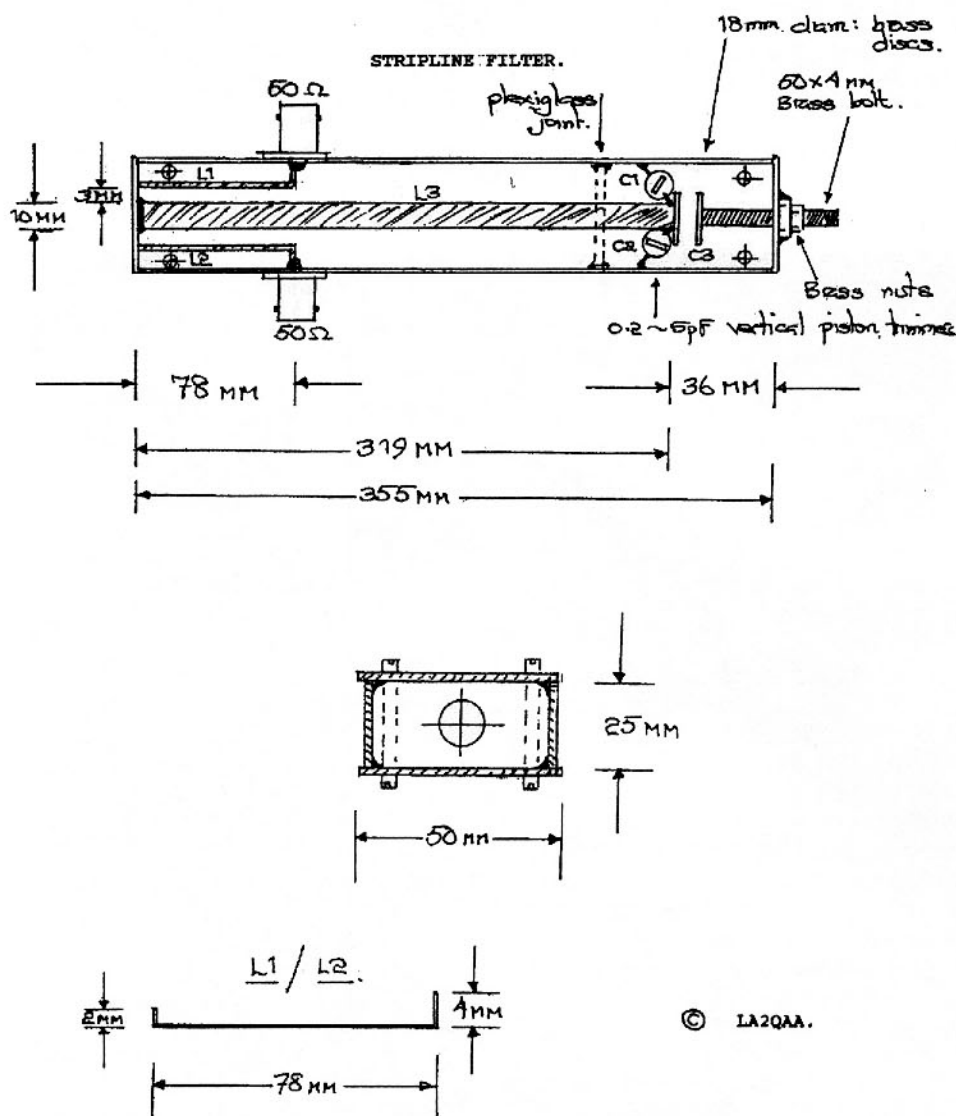


Figure 1. LA2QAA Stripline Filter

may mount the assembly: end-plate, tube, plexiglas spacer and disc to the edge of the cavity making sure the tube is centrally located. Now take the other end-plate and screw the 4mm brass bolt through the nut.

Solder the other disc to the head of the bolt. (When mounted, that forms the stator plate of the capacitor). Mount the end plate to the cavity making sure the discs are directly opposite each other. Solder all joints.

Place the lid underneath the box you've just made and bore two holes at each end...(see diagram)....for the nuts and bolts that hold the lid in place. Mount the piston trimmers...one each side of the tube....immediately behind the disc and solder one side to the disc/tube and the other side to the base of the cavity.

Carefully measure 78mm from the end of the cavity and mount a BNC or N-connector on each side. Take the two brass strips and mount them as shown in the diagram. The impedance can be fine-tuned by moving these strips nearer or farther away from the tube...the dimensions given are for a 50 ohm impedance.

For a professional finish I coated my filter using a black spray used normally for spraying automobiles.

To tune the filter....simply connect it to the transmitter using a 50 ohm load and adjust for minimum SWR. It's that simple!

If this filter doesn't get rid of the problem...you've done something wrong. Return to START without passing GO and DO NOT! collect 200 pounds/dollars.

If you still suffer from harmonic break-in after mounting a 70cm version of the filter on the sharp end of the 70cm rig.....SELL IT! and buy yourself a stamp album instead.

## Observations From Norway

Russ Tillman, Editor, *The AMSAT Journal* has just sent me a copy of the latest gossip from the amsat-bb. Regular readers will recall the simple quad I designed for the newcomer to satellite operating...particularly those with limited space. Apparently, everybody and his brother stateside has been phoning in wondering how such a simple antenna

stacks-up against 1) a vertical ground plane with 4 drooping radials, 2) a turnstile, 3) an eggbeater with reflector, and 4) a (single section) Lindenblad.

Consequently, the antenna has been put through it's paces in comparison tests. Tested for radiation pattern, polarization and adjusted gain....the verdict? (I quote)..."Given that this antenna is quite easy to build and performs better than a vertical or a turnstile, it would seem a good choice for a beginner or where space is limited.

There you go folks! Particularly the newcomer...it really does work! (I wouldn't have submitted it otherwise.) Remember!....you saw it in here first.

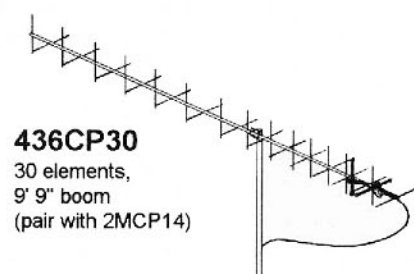
The latest trick?....6th August 97...FO-20...high powered SSB immediately adjacent to the beacon frequency....*slatter horriblis*....very clever...When one overmodulates a transmitter one doesn't just transmit on the dial frequency....one also transmits BOTH! sides of the suppressed carrier... (even though it's called *single* sideband)....the carrier is suppressed by "n" decibels in relation to the *required* sideband....as is the *other* sideband....this doesn't mean that the unwanted sideband and the carrier are not there...they are!....suppressed by "n" dB....overmodulating DOES NOT! give you more power output...it only distorts the signal and causes splatter....as in today's case...right on top of the beacon....deliberate or not, the station (s) concerned, please remember the above and use a bit of common sense.

Tip for the newcomer....usually, it is a waste of time calling CQ NORTH AMERICA on FO-20 when the satellite is over eastern Europe!...A CT1 station was in fact doing this....(perhaps he only had the old Commodore text tracking system?) One should check out the footprint...that is to say, the area of the Earth's surface covered by the satellite in question at the time one uses the transponder...in certain cases it is possible to communicate with stations outside the footprint but these cases are the exception rather than the rule. Even with the use of the now ancient OSCARlocator system it is possible to have a reasonable estimate as to whom one has a possibility of contacting at any given time. The object of the above is NOT to be holier than thou....it is of course meant to help the

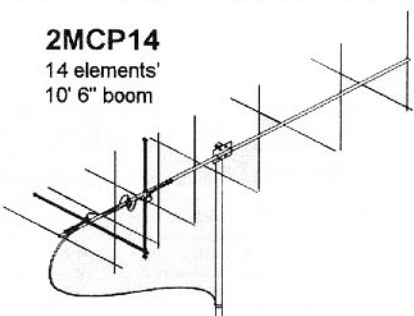
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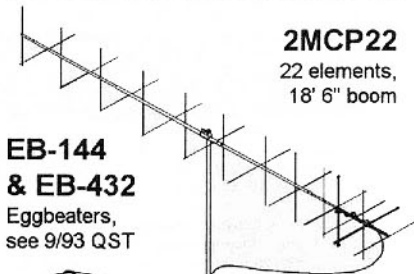
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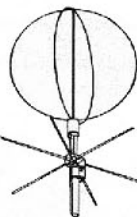


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newcomer. NOBODY! knows everything and if they claim to....they've probably seen too many *X-Files*.

I have heard complaints from users of FO-20 regarding lack of activity. I can only assume the complainants are operating at inconvenient times. Personally I find the activity increasing...on the weekend 08AU97 to 10AUG97 on FO-20 I worked the following stations. G7NFO, DG6OBP, RA3DQT, PE1RAH, LY2BAW, VE3EFF, KE0DH, F1UIM, GM7ZNI, SP5FKW, HB9OME, LA7SP, IO3ALU, and S56REG...(that's 14 countries)...as well as several duplicate countries...in three days...hardly a poor turnout for a LEO...(for the newcomer: Low Earth Orbit). All QSO's with five watts to the antenna...a five element vertical Yagi with a 6 element horizontal Yagi for the downlink. That translates to an EIRP...(effective radiated power)...of about 50W...which is adequate for FO-20. This is *not* QRP....QRP is 5W EIRP. I've worked my share of exotic DX when AO-13 was alive and kicking. With five watts to the antenna so power has never been a problem for me. However, I do of course have an advantage. I use those funny things stuck to the side of my head.....(he means EARS!...folks).

Tip for the newcomer....in the middle of a weekday the Europeans are mostly at work while the Stateside stations are still counting sheep....late afternoon and evening passes are best for high transponder activity when the satellite is somewhere between Greenland and Labrador, particularly at the weekend.

Everyone keeps saying...*see you on OSCAR 10*...at the moment (September) AO-10 is getting plenty of sunlight. Sunlight means power to the electronics which in turn means the transponder is up and running normally again. Unfortunately for me, AO-10 only gets to about 10 degrees elevation. (I'm too far north when the bird rises to my south) Consequently my *mainland hills* prevent any real DX operating. (Now you know why I'm an FO-20 fan.) But just you wait! When Phase 3D lifts off I'll be operating DX 25 hours a day; 26 on weekends!

A real pleasure working Mike G1HWY this morning...(17AUG97)...on FO-29 with (genuine)...S9 signals both ways...(at least at the start of the QSO). Mike told me he has to contend with 600 foot chalk hills at the lower elevations so it's not just *himself* who has to contend with potential

*reflectors*. However...I'd imagine Mike's *chalk* is worse than my *rock*, particularly due to it's absorptive properties at RF...mind you. Looking on the bright side...imagine having a 600 foot dummy load!. Mike also mentioned he was not too far from THE BOSS (James Miller, G3RUH)...(my words)...young Fred Southwell, our illustrious *OSCAR News* editor. I've had Russ Tillman (AMSAT Journal-NA) and several other notable people here so in fact only need a QSO with Fred to complete my WAAE....(*Worked All AMSAT Editors Award*).

Still Sunday, 17AUG97, FO-20 at 17:11 Greenwich mean time still as good as UTC (Universal Coordinated Time). Worked Dan, KE0DH again in Minnesota, Tony, KC8YO in Cincinnati and N7HXP in Seattle. Which gentleman complained of poor FO-20 activity? TIP: try *listening* first...it helps. Once more, *Observations* were mentioned. It seems *Limey humour* is still well received stateside.

Monday 18AUG97, 17:40 (Z). A most interesting QSO with Russ, W3JUZ in Pennsylvania via FO-20. Interesting in the fact that both FO-20 and FO-29 (in analogue) were at the same elevation and azimuth over the Atlantic. My downlink was S5 via FO-20 and S9+++ via FO-29....due to FO-29 drifting down over FO-20...(FO-29 has a slightly "higher" orbit therefore slightly higher Doppler rate). The effect was like being inside an echo chamber with a loop from LA2QAA through FO-29 via FO-20 to W3JUZ. I think Russ was quite confused but we managed an excellent QSO.

Just read a message from a "G" on the packet network asking for QRG info (frequency information) for AO-27. OK, so what's unusual about that?.....The message had a path via LA, SM, OZ, KA! and 15 GB7's.....Rather a long route don't you think? Most BBSs carry satellite information...If your *local* BBS doesn't carry the required info: a nearby one surely will. There is no need to go halfway round the world to get across the North Sea....by typing L? you will get a list of subjects contained in the BBS. Type AMSAT and you will get all the available AMSAT bulletins including *The Weekly Satellite Report*, several satellite frequency list's, news and views from AMSAT, etc...type KEP\* and you will get the latest element sets for all satellites. As I've previously

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mentioned, you can even TRACK any satellite by using the SERVER mode available on most BB systems. Why then did a Belgian station send a message worldwide wondering which frequency RS-12 used? A phone call to an Elmer would have been a lot quicker. Due to my writing a book for the satellite newcomer I simply don't have the time to send out regular bulletins on the Packet network.

Nice to work Terry, GILPS on FO-20. According to Terry it was our first QSO but I'm convinced I know that callsign from somewhere. In fact I said to Terry... "Nice to meet you again". Whereupon he informed me it was the first QSO. I'm still not convinced. It can be quite embarrassing having a head like a sieve! I've often worked a particular station on one pass then 90 minutes later worked the same station on the same satellite and *not known the operators name* even though I log all QSO's after the pass.....The XYL gets a bit huffy when we have guests and under the *introductions* I turn to her and say..."what did you say your name was?

I am in the process of writing a book for the potential newcomer to satellite operating. The experienced operator will be aware that most of the available literature is written *by the expert for the expert*. This doesn't help the newcomer much...neither do some of the suggestions *thrown* onto the Packet network. The book is designed specifically for the operator wishing to *have a go* at satellite operating and contains suggestions and help on most subjects to do with satellite operating. A *simple* and a more advanced glossary explain most of the terminology...a "how to..." for all current transponders be they analogue, digital, LEO or high flier. I believe there is a need for such a book. It has been suggested that the potential newcomer can learn from other AMSAT publications. Only one problem there mate! The *potential newcomer* more often than not isn't (yet) a member of AMSAT and consequently doesn't have access to the required information.

I've mentioned before the disadvantage of being *too far north* for AO-10. It does

have the occasional advantage though. This afternoon/evening FO-20 was in the middle of the Atlantic giving a window to the entire Eastern USA seaboard as well as the whole of western Europe. As can be imagined, the QRM was unbelievable!.....(and I used to think everybody could hear everyone else). However...as soon as central Europe dropped out of the footprint (bliss!) perfect armchair copy with KB8VAO and KB8TJX in Ohio as well as *me' mate*, KE0BH in Minnesota. Comical to watch *the trend*....QRM!.....more power...more! QRM...even more! power...mine's bigger than yours! BOOM! BOOM!...MORE POWER BABY!...MORE POWER!!....no QSO's....just "complaints" of QRM....I wonder what the Americans say on their local 2m nets re: the standard of European operating.....just a thought.

A small reminder to the *newcomer*.....one of the main reasons a satellite has a beacon signal is so that the said beacon can be used as a *reference* signal. No transmitted signal should *ever!* be stronger than the beacon.....*It is not*

## Satellite Orbital Elements

Ray Hoad, WA5QGD

| Satellite      | AO-10          | AO-27          | FO-30          | FO-29          | RS-10/11       | RS-12/13       | RS-15          |
|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| Catalog Number | 14129          | 22825          | 20480          | 24278          | 18129          | 21089          | 23439          |
| Epoch Time     | 97312.29306154 | 97324.20424157 | 97324.35464937 | 97324.06849507 | 97323.97352569 | 97324.04627804 | 97324.17408574 |
| Element Set    | 514            | 600            | 11             | 152            | 435            | 61             | 287            |
| Inclination    | 26.394         | 98.5303        | 99.0657        | 98.521         | 82.9222        | 82.925         | 64.814         |
| RA of Node     | 117.9426       | 34.8433        | 256.6962       | 343.9064       | 123.5885       | 163.0699       | 260.6041       |
| Eccentricity   | 0.602999       | 0.0009046      | 0.05406        | 0.0352221      | 0.0011877      | 0.002795       | 0.0146032      |
| Arg of Perigee | 166.3756       | 138.8869       | 23.9103        | 142.0954       | 142.4197       | 222.1758       | 102.1029       |
| Mean Anomaly   | 222.7043       | 221.2994       | 338.6126       | 220.5555       | 217.779        | 137.7248       | 259.6298       |
| Mean Motion    | 2.05880583     | 14.27744838    | 12.83240535    | 13.52634373    | 13.72385671    | 13.74088757    | 11.27528573    |
| Decay Rate     | 0.00000077     | 0.00000048     | -0.00000071    | -0.00000079    | 0.00000024     | 0.00000072     | -0.00000039    |
| Epoch Rev      | 10832          | 21633          | 36473          | 6219           | 52160          | 34056          | 11952          |
| Satellite      | RS-16          | RS-17          | UO-11          | UO-14          | AO-16          | DO-17          | WO-18          |
| Catalog Number | 24744          | 24958          | 14781          | 20437          | 20439          | 20440          | 20441          |
| Epoch Time     | 97324.27938388 | 97324.29037055 | 97323.95421197 | 97324.20493926 | 97324.21453111 | 97324.18484298 | 97324.18632167 |
| Element Set    | 111            | 21             | 35             | 327            | 134            | 128            | 113            |
| Inclination    | 97.263         | 51.66          | 97.8524        | 98.5085        | 98.529         | 98.5333        | 98.5305        |
| RA of Node     | 226.3815       | 21.0688        | 299.1097       | 42.4197        | 45.7187        | 46.6603        | 46.5404        |
| Eccentricity   | 0.0005047      | 0.0007276      | 0.0010586      | 0.001163       | 0.0012048      | 0.0012094      | 0.0012657      |
| Arg of Perigee | 254.8337       | 344.5702       | 222.1848       | 105.6531       | 107.67         | 106.276        | 107.8721       |
| Mean Anomaly   | 105.2343       | 15.506         | 137.8541       | 254.5944       | 252.5801       | 253.9755       | 252.3845       |
| Mean Motion    | 15.32702167    | 15.61307514    | 14.69618369    | 14.299826      | 14.30027724    | 14.30171459    | 14.30137446    |
| Decay Rate     | 0.00006607     | 0.00037742     | 0.00000238     | 0.00000065     | 0.00000036     | 0.00000068     | 0.00000004     |
| Epoch Rev      | 3998           | 259            | 73413          | 40851          | 40853          | 40856          | 40856          |
| Satellite      | LO-19          | UO-22          | KO-23          | KO-25          | IO-26          | MIR            | Phase 3D (est) |
| Catalog Number | 20442          | 21575          | 22077          | 22828          | 22826          | 16609          | 99934          |
| Epoch Time     | 97324.28087998 | 97324.20742779 | 97324.09979025 | 97324.22744777 | 97324.23073470 | 97324.48140536 | 96260.25520000 |
| Element Set    | 111            | 833            | 735            | 603            | 615            | 788            | 3              |
| Inclination    | 98.5332        | 98.2808        | 66.0846        | 98.5283        | 98.532         | 51.655         | 60.0203        |
| RA of Node     | 47.392         | 19.0832        | 178.7948       | 35.2471        | 35.1571        | 20.0957        | 342.7876       |
| Eccentricity   | 0.001353       | 0.000772       | 0.0000821      | 0.0010796      | 0.0009463      | 0.0007278      | 0.6752895      |
| Arg of Perigee | 108.6996       | 137.2145       | 139.2656       | 124.3177       | 140.8354       | 351.88         | 180.1221       |
| Mean Anomaly   | 251.5658       | 222.9645       | 220.8424       | 235.9026       | 219.3513       | 8.276          | 179.5089       |
| Mean Motion    | 14.30254745    | 14.37096775    | 12.86304368    | 14.28201342    | 14.27855614    | 15.6087686     | 1.51063698     |
| Decay Rate     | 0.00000027     | 0.00000039     | -0.00000037    | 0.00000049     | 0.00000007     | 0.00000739     | 0.0002         |
| Epoch Rev      | 40860          | 33289          | 24780          | 18448          | 21635          | 67147          | 2              |





Perry Klein, W3PK (foreground) and other attendees at the Washington, DC Area AMSAT Meeting and Seminar that was held November 2, 1997 at the NASA Goddard Space Flight Center. (Photo by Charles Heisler, K3VDB)

necessary...if you can hear the beacon you can hear transmitted signals at the same strength...if you *can't* hear the beacon adequately.....then your receiving system *is not good enough* and steps should be taken to improve it. By increasing your transmitter power to overcome a less than adequate receiving system is counter productive, wastes transponder power and causes unnecessary QRM. There will always be the unintelligent clowns who deliberately swish their VFO's when you're

calling CQ...(luckily, in the minority)....just as there are the 20m operators that suffer severe bouts of stomach ulcer attacks when you ask if the frequency is in use.....on 20m one can.....due to ionospheric idiosyncrasies, plausibly say....."I didn't hear him" etc.....on satellites however, that excuse doesn't hold water. Such ill mannered behavior can be heard by everyone and should of course be ignored...as I've mentioned before...the *object of the exercise* is to irritate...by



Photo by K3VDB

Participants of the Washington, DC Area AMSAT Meeting and Seminar held November 2, 1997 at the Goddard Space Flight Center. To learn more about Washington, DC Area AMSAT Area efforts see their WWW page at <http://garc.gsfc.nasa.gov/~simsat/ssamsat.html>. (Photo by Charles Heisler, K3VDB)

completely ignoring the sufferer of severe tummy trouble/VFO swisher...you'll find he gets bored and goes away.....*little things amuse little minds*.....don't become a termite!

Here's an interesting one.....The 10th of September...just completed a pleasant QSO with a friend in Canada. At 13:56Z as FO-20 was over the Atlantic and all of southern Europe passed out of the passband except for northern England, Ireland and Scotland I began calling CQ Canada...downlink S8...nice strong clear signals....the passband was quiet for the first two calls. But what was that in the background?....SSTV signals.....(note that I say FO-20....FO-29 was way behind the mountains in the opposite direction so no possibility of *experimental* signals)....I paused...so too did the SSTV...I waited a while...(quiet)....began calling CQ again...more SSTV...(I was amused). No shadow of a doubt this was meant as deliberate QRM...(sorry mate!, you failed...trust you heard the excellent QSO). Just a small point here....100 percent duty cycle mode on LEO....in a case like the one described...intelligence on a scale from one to ten?.....wouldn't even "move the meter"...(think about it)...One day, hopefully, the penny will drop. The following is perfectly true....if there are 20 stations in a pile-up, all *gibbering* away at the same time.....usually while the *DX* station is still transmitting! (semi-duplex...what's that?)....A QRP signal sticks out like a sore thumb!....(ask any QRP operator). Incidentally...for the would-be SSTV *operator*....(don't know who he was.....nor do I care!)...intelligence is measured equivocally from the neck up!....as opposed to the socks down!....so if I were you I'd stick my thumb in my mouth and *have a little think*....you never know...you might learn something....(Aye!, n' pigs might fly.....LA2QAA).

Have a good day and 73,

John

*Editor's note: John has a new address:*

Torvveien 10  
N-6520 Frei, Norway  
LA2QAA @ GB7DJT or LA2QAA @  
LA6K.KSU.T.NOR.EU ■



# S-Band From DOVE as a Test Signal Source

Jim White, WD0E

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Many Amateurs are looking forward to the launch of Phase 3D and the potential for an excellent downlink from that satellite's 2400 MHz transponder. Several inquiries about the DOVE (DO-17) S-band transmitter have been received from those working on equipment for that band and looking for a signal to use for testing. In order to facilitate testing of S-receive equipment we are attempting to keep the DOVE S band transmitter on as much as possible. This article presents some information about the DOVE 2.4 GHz transmitter which should be useful to those working on receive equipment.

The DOVE S-band transmitter generates 0.8 Watts to a bifilar helix mounted on the +Z surface of the satellite, 1 3/16 inches (2.95 cm) in from one edge. The antenna is right hand circular in polarization and is essentially omnidirectional. The +Z surface is generally pointed away from the earth in the northern hemisphere and toward the earth in the southern hemisphere. If you are listening from north of the equator you should hear deep fades about every 30 seconds or so as DOVE rotates about its Z axis and the S antenna is blocked by the body of the satellite. Below the equator the signal is pretty steady because the antenna is pointed more or less down and there is no blockage. (See "Microsat Motion and Stabilization", *The AMSAT Journal*, September 1990 and *The AMSAT Space Symposium Proceedings*, 1990, for further information on the motion and stabilization system for DOVE and the other original Microsats.)

The data transmitted on S-band is the same as that on 2 meters, i.e. telemetry and a short text broadcast about every 30 seconds to 1 minute depending on power management needs. All data transmissions are ASCII text. The modulation is 1200 baud PSK.

While just about any functioning S-receive equipment will hear it, decoding the data from this transmitter presents an interesting challenge. The carrier suppression failed at launch resulting in a signal with modulation about 20 dB below the carrier. A few packets have been successfully decoded by using a tracking DSP notch filter to suppress the carrier. That

technique requires a receive system capable of achieving about 30 dB signal-to-noise to provide modulation about 10 dB above the noise, and a way to eliminate the carrier before feeding it to the PSK demodulator. Some time ago K0RZ successfully decoded a couple of packets by connecting the received audio from the radio through a DSP tracking notch filter to a TAPR PSK demodulator. Using a 4 foot dish and a preamp/converter of his own design he was able to achieve adequate SNR to provide enough modulation to the demod that it was able to both tune the radio via the mic click interface and make bits. Usually a radio can be set to 10 Hz steps early and late in the pass when the rate of Doppler change is low but 100 Hz steps are necessary during most of the pass to keep up with the rapid Doppler change. The packets decoded were very short ACKs used during loading (about 8 bytes) and success was only achieved in that short span of time when DOVE was well above the horizon and the range was reduced, but before the rate of Doppler change required 100 Hz steps.

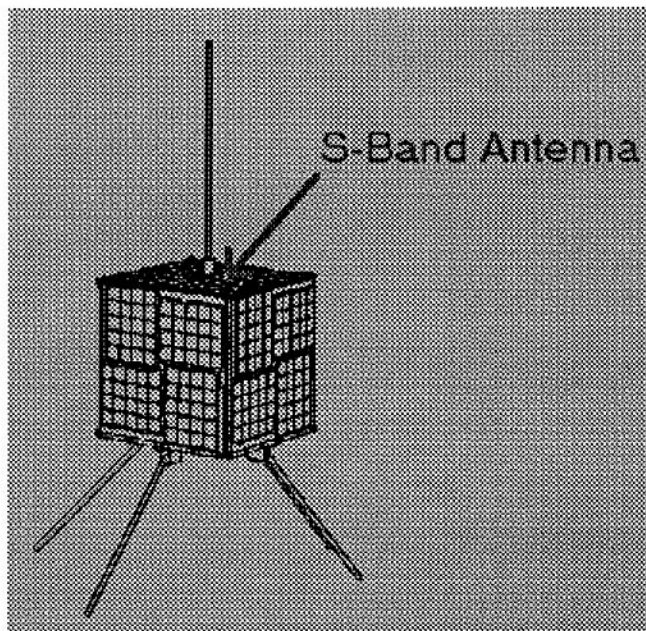
Like the UHF PSK transmitters of AO-16, WO-18 and LO-19 the DOVE S-band transmitter is on all the time and sends flags when no data are being sent. These flags produce a buzzing sound when listening with a receiver in SSB mode and without filtering or other aids. If you can hear the modulation buzz your receive system is fairly sensitive. If you can detect the buzz change pitch as data are sent, your receive is better than 20 dB SNR. If you can notch out the carrier, run the resulting signal into a PSK demod and decode a packet you have a pretty darn good S-receive system.

As noted above making good bits at these rates of Doppler change is a challenge. Generally it is necessary to tune a radio 100 Hz per step to keep up with the Doppler at TCA. At that tuning speed if the radio steps in the middle of a

packet the data will nearly always be corrupted. At TCA the radio will be required to step several times a second. When experimenting with receiving data it might be interesting to try different tuning techniques such as setting the radio for 10 Hz steps and manually changing frequency using the lock detector on the PSK demod as a tuning indicator.

It's possible that in the near future we may have a software demod for this signal that runs on a Pentium class computer and a sound card. Audio from the receiver would be connected to the sound card without need for pre-filtering or notching. If this effort is successful it would provide an easier way to test the quality of an S-receive system. It also has promise as a way to facilitate the continued use of other three Microsats should carrier suppression become a problem in their PSK transmitters.

UoSAT-11 (UO-11) also has an operational S-band transmitter. According to the UoSAT ground controllers it originally transmitted about 100 mW into a small helix but suffered partial failure recently and its power is reduced. Reports from those who have heard it indicate it is much weaker than the DOVE signal so should provide an additional way to check the quality of a receive system. ■



S-Band antenna location on DO-17.

# Report on the International Amateur Radio Union International Satellite Forum Held in Toronto Hans van de Groenendaal ZS5AKV, [hans@intekom.co.za](mailto:hans@intekom.co.za)

Some years ago it was recognized that the interest of the International Amateur Radio Union (IARU) and International Satellite Community would best served if the IARU International Satellite Forum was held alternately in conjunction with the AMSAT-UK Satellite Colloquium and the AMSAT-NA Space Symposium. This year was the first time that the Forum was held in conjunction with the AMSAT NA Space Symposium. The symposium was held in Toronto from October 17-19, 1997.

## AMSAT NA Space Symposium

Several side meetings were held with the International Space Station group primarily focusing on frequency planning for current SAREX and *Mir* events and paving the way for international allocations for the ISS. Various proposals were on the table. Tom Atkins, VE3CDM, Region 2 IARU President, also attended these discussions and together we formulated a position paper which was shared via e-mail with the IARU AMSAT Frequency Coordinator Graham Ratcliff, VK5AGR. This paper was discussed at IARU International Satellite Forum and accepted. (More later in this report).

At the AMSAT-NA Space Symposium, papers of a very high standard were presented leaving one with the realization that research and development by Radio Amateurs is alive and well. These developments will not only impact satellite operation but will find their way into all operational spheres of the Amateur Service. It supports the IARU Administrative Council's decision to establish an IARU AC Outlook Committee so that these new developments can be shared more widely and a need for the IARU PriCom group to pro-actively share these development trends widely.

## Keynote Address

Hans van de Groenendaal ZS5AKV delivered the keynote address at the Annual AMSAT-NA dinner attended by over 200 delegates. The title of the keynote address was *Amateur Radio's Contribution to Research and Development*.

## IARU International Satellite Forum

The forum was held on Sunday morning, October 19, 1997 and attended by 77 delegates including all the prominent players in the USA and Canada as well as representatives from a number of European Countries.

The Forum was introduced by Ray Soifer, W2RS on behalf of AMSAT-NA and Tom Atkins on behalf of IARU. The following topics were discussed:

### • Monitoring of Satellite Frequencies

Hans van de Groenendaal reviewed the decisions taken by the Region 1 Conference to introduce such an activity and the agreement that Ron Roden the IARU Region 1 IARUMS Coordinator would on a trial basis act as coordinator.

The concept was agreed upon. The AMSAT-NA Board will discuss the proposal and formulate the way forward for the USA and Canada. It was agreed that the ARRL should be approached to coordinate the input and any action taken to remove violators and to keep Ron Roden in the loop.

It was also agreed that an education campaign was needed to enable monitors to identify unauthorized operators especially in view of the shared bands.

The view was also expressed that a paper should be prepared for discussion at the Region 2 Conference. ZS5AKV was tasked to submit a paper to the Region 2 EC for their consideration and action.

ZS5AKV was also requested by the President of AMSAT-NA, Bill Tynan, W3XO, to submit an article for publication in *The AMSAT Journal*.

### • Satellite Frequency Coordination

Tom Atkins, VE3CDM took the floor and represented Graham Ratcliff, KK5AGR who had submitted a number of issues for discussion.

The role of the IARU AMSAT Frequency Coordinator was discussed. It was agreed that the terms of reference continue to apply. The coordinator's function is to evaluate requests and make recommendations. In this process he will often consult with major satellite builders.

The coordinating function is not a regulatory or allocation function, but a process to assist future satellite builders/operators to select the best frequencies for their operation in order to achieve the optimum use of the available spectrum.

On the question when is a Satellite an Amateur Satellite? It was agreed that the criteria as set out in the AMSAT-NA position paper on this subject will be applied.

It was agreed that the IARU Satellite Adviser should deal with these issues and assist the Frequency Coordinator to resolve the status of the request.

It was also agreed to circulate the AMSAT NA Position paper to all Satellite Groups listed on the AMSAT-International e-mail list for their acceptance. Ray Soifer will circulate the paper with a request that feedback be sent within 30 days to the IARU Satellite Adviser.

### • Band Planning

The question of band planning for satellite operation was discussed. It was agreed that it is not a good idea. There is however merit in keeping analogue and digital signals apart when and where practical. It was agreed that the IARU AMSAT Frequency Coordinator should consider each case on its merit.

### • Used By Date Requirements

It was agreed not to impose a used by date requirement. The IARU AMSAT Frequency Coordinator should however keep regular contact with Satellite groups for which he has coordinated/recommended frequencies.



### • Wednesday- Experimental Day

The meeting recommended that this be continued and that the IARU Satellite Adviser and Frequency Coordinator promote more experimentation.

### Reappointment of the IARU AMSAT Frequency Coordinator

ZS5AKV proposed that Graham Ratcliff, VK5AGR be reappointed. This was unanimously approved by the meeting. Several speakers recorded their appreciation to Graham for his continued services to the satellite community.

### International Space Station

Frank Bauer, KA3HDO discussed the current problems experienced by SAREX and *Mir* operations and the impact that these problems may have on the International Space Station.

There are two basic requirements:

- A universal world-wide uplink frequency on two meters and
- A universal world-wide downlink frequency on two meters.

After intensive discussion it was recognized that the countries in Region 1 had already compromised by making 144.490 MHz available as a SAREX uplink.

AMSAT-NA and ARRL have been working closely with TAPR and other USA groups to make 145.800 MHz available as a downlink. Currently the Automatic Reporting System (APRS) operates on 145.790 MHz making 145.800 MHz unusable for SAREX and *Mir* operations. All indications are that this will be achieved in the short term.

The following proposal was unanimously accepted and will be put forward to the next IARU Region 1 VHF meeting to be held in February 1998 in Vienna and the Region 2 Conference to be held in Venezuela in October 1998. Representation also to be made to Region 3. ZS5AKV and VK5AGR to prepare the submission.

### Manned Space Missions

#### 2 Meters:

- Uplink primary: 144.490 MHz Worldwide. Additional uplinks: 144.470 MHz and 144.450 MHz Worldwide
- Downlink primary: 145.800 MHz. Additional downlinks 145.8125 MHz and 145.990 MHz (back-ups)

#### 70cm:

The following two segments be set aside for manned-space operation:

- 435.700 - 435.800 MHz
- 437.500 - 438.000 MHz

Several meetings were held prior to the IARU Satellite Forum at which a new schedule for *Mir* operation was proposed. The Forum endorsed the proposal. Thomas Kieselbach, DL2MDE of the DARC/SAFEX group undertook to discuss the proposal with the *Mir* Ground Control Station.

### December 1, 1997 - February 28, 1998 - 70cm/2m Validation Operations:

- Uplink: 437.850 MHz
- Downlink: 145.800 MHz

### March 1, 1998 - May 31, 1998 - 2 Meter Operations:

- Uplink: 144.490 MHz
- Downlink: 145.800 MHz

After the experimental period the crossband operation to be continued during odd months and 2 meter operation during even months.

### Other UHF/Microwave Frequencies

There was unanimous agreement that higher frequencies above 70cm, new modulation techniques and operating modes should be considered for future manned space missions. The IARU Satellite Adviser and IARU AMSAT Frequency Coordinator were requested to seek input from the Region One VHF Committee and Regions 2 and 3 Executive Committee. It was also proposed and agreed that they should make input to the IARU AC Outlook Committee which is being chaired by Tom Atkins, VE3CDM.

### General

Bill Tynan, W3XO, AMSAT-NA President asked that consideration be given to approaching ITU about Amateur Satellite operation in the 50 MHz and the 29.700 - 30.000 MHz bands. This was unanimously supported. ZS5AKV and VK5AGR to formulate a proposal to be submitted to the AC.

The meeting closed at 12:00 noon with a vote of thanks to AMSAT-NA. The next meeting is scheduled to coincide with the AMSAT-UK Colloquium in July 1998. The next North American IARU Forum will be held in 1999. ■



The AMSAT Meeting and Space Symposium provided an opportunity to discuss *Mir* and SAFEX frequencies. From left to right, Hans van de Groenendaal ZS5AKV; Thomas Kieselbach, DL2MDE; Will Marchant, K6ROL; Lou McFadin, W5DID; Frank Bauer, KA3HDO; and Tom Atkins, VE3CDM. (KC6JVB photo)





Acting in his role as President, Bill Tynan re-appointed the remainder of AMSAT-NA's current Officers. In a related action, he also welcomed former ARRL New England Director Bill Burden, WB1BRE, who will now serve as AMSAT-NA's Vice President for Strategic Planning. Bill brings a wealth of experience in both engineering project management as well as in planning corporate strategic initiatives to the AMSAT team. His skill and experience will prove invaluable as AMSAT contemplates future projects beyond Phase 3D.

Lastly, the Board of Directors selected a team headed by Russ Tillman, KC5JVB (AMSAT's Journal Editor) to host next year's AMSAT Annual Meeting and Space Symposium at Vicksburg, Mississippi on October 9-11, 1998.

A complete text of the recently completed Board of Directors Meeting's Minutes will appear in the January/February 1998 issue of *The AMSAT Journal*. ■

### ASUSat-1 News

Assi Friedman, 4Z7ABA/KC7WSZ, of Arizona State University recently informed AMSAT-BB users on the status of ASUSat-1 (see May/June 1997 of *The AMSAT Journal*). Presently, ASUSat-1 is in the integration phase and will have a FM repeater similar to AO-27. ASUSat-1's FM repeater will have an uplink in the VHF band (145.990 MHz) and a downlink in the UHF band (436.700 MHz). The difference between the AO-27 and the ASUSat is that the repeater will be PL tone-operated so the transmitter will go on the air only if a user wants to access it. This will enable an improved power budget, as well as make the transmitter a bit stronger than AO-27's downlink.

In addition to this, ASUSat-1's digital communication system will be available to the Amateur Radio operators. There is not a Pacsat-type application on board, as there is not a Ram-Disk on ASUSat-1. In addition, new experiments are being considered, such as an APRS store/dump digital repeater (9600FSK). Also digital and analog signals will be multiplexed on a single downlink.

Right now there is not a scheduled launch for ASUSat-1 but we have a good chance of getting a lift from our sponsors at Orbital Sciences Corporation in mid-1998. ■

### AMSAT-NA Financial Statement and Auditor's Report Available

AMSAT-NA's annual financial statement and auditor's report are available for member's review. If you would like to receive a copy send a self-addressed 10" x 13" envelope to the AMSAT-NA headquarters address that is provided on page 3 of this issue. ■

### Bill Tynan, W3XO Named RCA Fellow

AMSAT NA President Bill Tynan, W3XO, has been elected a Fellow of the Radio Club of America (RCA). Bill is scheduled to receive his award at the Club's annual dinner, to be held November 21, 1997 in New York.

The Radio Club of America, founded January 2, 1909, is the world's oldest radio communications society. The Club provides grants in aid to educational institutions and other worthy causes related to radio communications, as well as sponsoring technical meetings and publishing a journal, *Proceedings*. Its membership includes many leaders in amateur, commercial and government communications. Bill has been a member of the RCA since 1992. ■

### SATPX Award Available

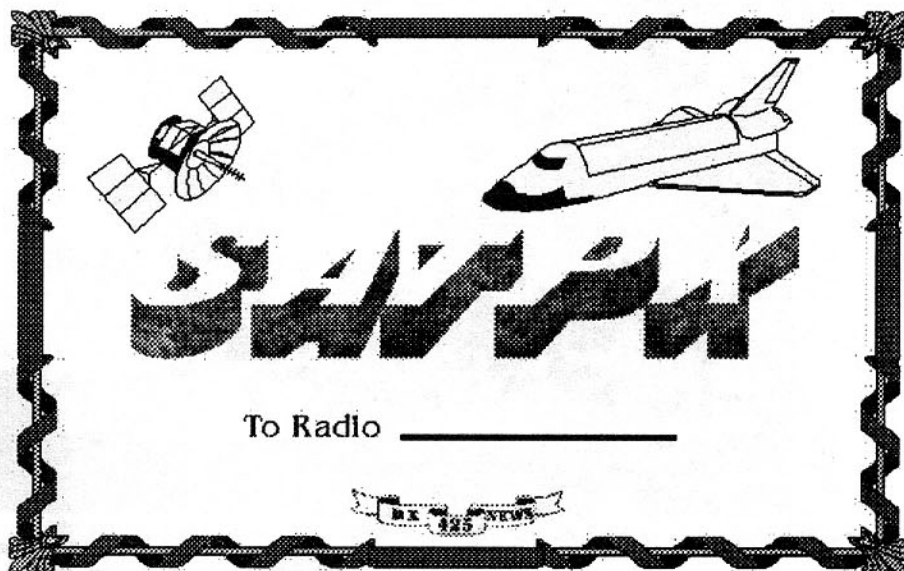
Another satellite award is available for fifty different prefixes worked or heard on Amateur Radio satellites (*Mir* and Shuttle SAREX call signs are valid). It is not necessary to have a QSL card, but a log with

exact date, time, call sign worked/listened, frequency, mode, and satellite is required. To obtain an award, send \$5.00 to: SATPX Award, c/o Maurizio Bertolino (i121171@amsat.org), PO Box 2, 12022 Busca (CN) Italy. Additional details can be found via the 425DXNews WWW page: <http://www-dx.deis.unibo.it/htdx/> ■

### North Texas Balloon Project - Mission #8 Post-Flight Report

The North Texas Balloon Project (NTBP) successfully launched its second high altitude balloon mission of 1997 on September 6th at 1539 UTC from Clifton Municipal Airport, Texas. Estimated burst altitude was 92,000 ft and the flight duration was just over two hours. Once again, HF net coverage was provided by Keith Pugh, W5IU.

There were a significant number of experiments on NTBP#8 and almost everything worked as expected. The crossband repeater, digipeater, and parrot repeater all worked flawlessly throughout the flight. The 35mm still camera appears to have functioned well and photos are available via the NTBP WWW site. The GPS had some problems acquiring satellites in the beginning, but appears to have performed better as the flight progressed. It appears that the Trimble GPS receiver does indeed have an altitude limitation, however it resumed good position reporting during the descent. The new 1.2 GHz FM ATV transmitter worked very well and we are extremely impressed with the video quality. Unfortunately, the ATV antenna departed its payload shortly after descent began due to excessive aerodynamic forces.



An example of the SATPX award available from DX 425 News.



The payload was recovered about 10 minutes after landing and all DFing teams were at the landing site within 30 minutes of landing. Some of the DFing teams used GPS downlink information for the APRSA4 and Street Atlas USA software combination, and it worked extremely well. Other DFing teams used simple Yagis or Doppler units. The recovery team performed very well considering that the payload traveled nearly twice the distance (30.5 miles) as the predicted 17.8 miles. Some units even beat the chase plane to the scene! The payload landed approximately seven miles south-southwest of Hico, Texas.

At the conclusion of NTBP#8, Doug Howard, KG5OA stepped down as project coordinator in order to devote more time to his family. The project will continue since it has always been a large team effort. To keep up to date on the latest NTBP activities, check the following URL periodically:  
<http://procorp.com/procorp/ntbp/index.htm> ■

## Amateur Radio Satellite Station Sets Milestone

On September 21, 1997, the KE4ZKW Amateur Radio Satellite Station, the focal point of the Amateur Radio Exhibit in the Virginia Air & Space Center in Hampton, Virginia, set a performance milestone not soon to be equaled. It had operated 24

hours per day for two full years in uninterrupted communications with other Amateur satellite stations around the world, except for maintenance, minor repairs, and upgrades. The station system operates at 9600 baud, digital, hands-off, fully automatic mode, unless initiating or reading of message traffic is required. Communications are through three Amateur Radio satellites- UO-22, KO-23 & KO-25, designed, built, and launched into orbit for Amateur Radio use.

A Special Event Station, using both satellite frequencies and the familiar 20 & 40-meter Amateur Radio high frequency bands, was manned during regular Center open hours for the two-day weekend following the record setting date. Congratulatory messages were received from over 135 hams around the globe despite the very high local industrial noise levels of from S-3 to an often S-8 or 9. Many visitors watched Amateur Radio in action and listened attentively during these two days of high activity.

During the past year, foreign visitors and licensed amateurs have been invited to sign the special Visitor Log at the exhibit. Over 400 entries have been made by visitors from over 40 different countries. Whenever foreign visitors arrive who are not conversant in English, they can learn what this exhibit is all about from one of the many translations describing the operation of the station. They usually show their surprise and pleasure with many

smiles and gestures. Also, an Internet web site ([www.seva.net/vascarg](http://www.seva.net/vascarg)) was established. In its eleven months of counting, the average monthly hits exceed 200 with a high of 310 in a single month. Numerous visitors have stated that they first learned about the Virginia Air & Space Center from our informative site on the world-wide web.

Trained Station Operators are now on duty every day of the week during peak visitor hours, as well as for specially pre-arranged group needs. Their presence is to explain the exhibit and the satellite station operations punctuated with many pictorials and illustrations. Their interest grows markedly when a satellite comes into our radio "view" and the computer screen begins to report the activity.

An in-work upgrade plan will soon permit local area Hams, through packet radio and a remote access computer, to view the satellite directories and all recently downloaded message traffic. Soon after this is on-line, software will be installed on the remote access computer to permit them to deposit outgoing messages in the remote access computer. Following screening by a control operator, messages will be remotely transferred to the station computer to be uploaded to the proper satellite. This new capability for the local Amateur Radio community is expected to increase substantially the interest in satellite communications. (Thanks to Ken Pierpont, KF4OW.) ■



Amateur Radio Station KE4ZKW exhibit at the Virginia Air & Space Center, Hampton, Virginia. The satellite station radio gear is in the left operating console and the HF station is in the right operating console. Computers power supplies and other equipment are in the lower cabinets. The left cabinet displays examples of early Amateur Radio equipment, some dating back to the early 1920s. (Photo by Kenneth Pierpont, KF4OW)



## Sputnik-40/RS-17 In Orbit!

(AMSAT News Service, November 9, 1997) The working model of Sputnik is now in orbit and on the air. Reports from several places indicate the working model Sputnik-40 satellite launched Monday, November 3, 1997 from the *Mir* space station is currently *beeping* on its downlink frequency of 145.820 MHz.

The satellite commemorates the 40th anniversary of the original Sputnik 1 satellite (see pages 27, 28, and 31 of the September/October issue of *The AMSAT Journal*). Sputnik 1, launched by the Soviet Union in 1957, was the first artificial Earth satellite. The original Sputnik 1 transmitted a similar beacon on approximately 20 MHz.

The one-third scale Sputnik model was launched by hand from *Mir* during a space walk by Cosmonauts Pavel Vinogradov and Anatoly Solov'yev, who turned on the transmitter and checked out reception aboard *Mir* before launch with help from US astronaut David Wolf, KC5VPF. The beacon is audible in either FM or SSB mode. The beacon transmitter runs approximately 100 mW.

On Reunion Island, a great cheer went up as hams, students and teachers gathered to listen to the Sputnik model as it passed overhead on its initial orbit and heard the beacon signal from space for the first time. Students from the FR5KJ radio club at Jules Reydellet College in St Denis, Reunion Island, and at the Polytechnic Laboratory of Nalchik Kabardine in Russia cooperated in building the mini-Sputnik. The Russian students built the satellite body, while the French students fabricated the transmitter inside. Two working models of the Sputnik were assembled and transported to *Mir*, but only one was launched.

The frequency of the beacon indicates the satellite's internal temperature. The scale runs from 1361 Hz at 50°C to 541 Hz at minus 40°C.

### Sputnik-40 History

The history of the Sputnik-40 project is one of international cooperation and perseverance. It began on February 20, 1997 when an agreement was signed between Russia and France to commemorate the 40th anniversary of the launch of the first artificial satellite of the Earth: Sputnik-1. Two groups

of high school students would cooperate to build a functional scale model (1:3) of the original Sputnik satellite. Students from Nalchik in Russia were to build the body of the satellite, and the students from Reydellet School in La Reunion Island would build the radio transmitter. Soon after the project kick-off, AMSAT-France also entered the effort to provide technical support to the two teams building the satellite.

The Aero-club de France and the Russian Federation of Astronautics helped raise funds for the transportation of the 3 kg model to MIR and for its launch by the MIR cosmonauts during an EVA. A worldwide fund-raising drive called *Forty sponsors for the forty years of Sputnik* with 40 shares tagged at (US) \$6,000 each, was conducted to raise needed funds for the project. Gerard Auvrey, AMSAT-France Vice President, says that the team is still looking for eight more Sponsors to fully finance the project as there are some bills yet to pay.

Nalchik is the capital of Kabardine in the Balkan Republic. It is an industrial town located in the Caucasus, about 2000 km from Moscow. Sparked in large measure by radio contacts with French cosmonauts Jean Pierre Haignere and Claudie Andre-Deshays aboard the orbital station MIR, the Jules Reydellet's radio club on Reunion Island also competed and was selected to represent the French school in the Sputnik project.

Miles Mann, WF1F, says reception reports can be sent directly to Sergei Sambourov, PO Box 73, Kaliningrad-10 City, Moscow Area, 14070, Russia. Include an SASE and one IRC for a certificate. ANS now understands that F1FY has also volunteered to be the official QSL manager for Europe. Also Bruce Paige, KK5DO, was investigating the possibility of setting up a similar arrangement for North American stations to get their Sputnik-40 reception reports to Russia.

Reception reports can now also be sent directly to The

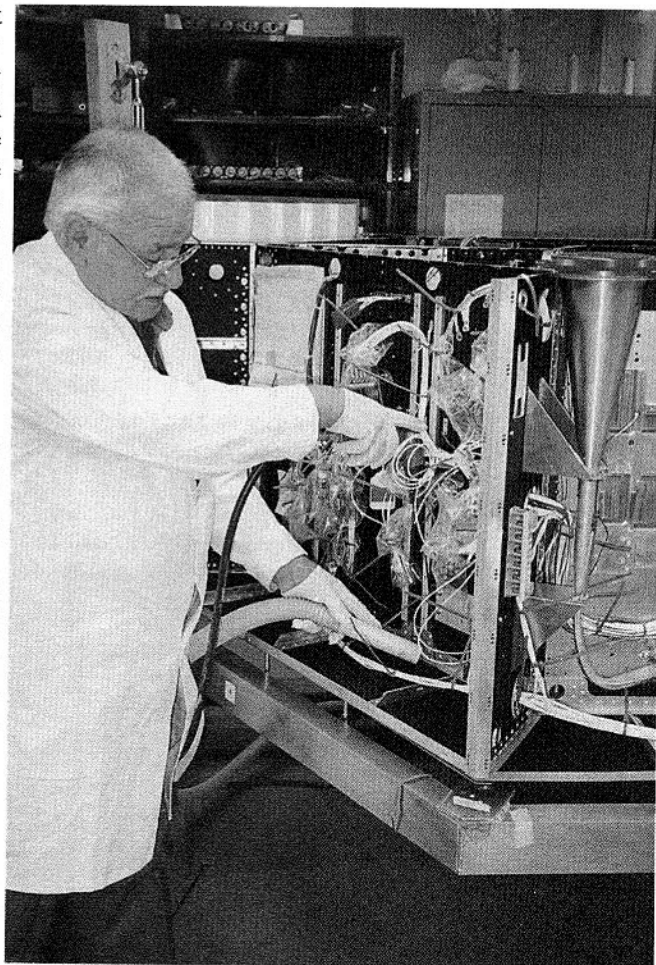
Radio Club of Jules Reydellet school on Reunion Island. Those whose reports are confirmed will receive a 15 x 21 cm, 4 color certificate on high quality paper with number identification and the radio club stamp. Requests for these certificates should be made only by letter with an SAE (15 x 21 cm) and 2 IRCs. The certificates will be sent after the end of PS2's transmission. *Please do not send requests by e-mail!*

The mailing address for FR5KJ is:

FR5KJ Radio Club  
103 Rue de la Republique  
97 489 Saint Denis Cedex  
Reunion Island

### Sputnik-40 Technical Description

- Spaceframe: A sphere of 200 mm outside diameter, weighing about 3kg.
- RF Power: 100 mW radiated in 4 antennas with circular polarization.
- Attitude Control: None.



AMSAT-DL's Structural Specialist Konrad Mueller, DG7FDQ, does an interim cleaning of the Phase 3D spaceframe just following major structural upgrade efforts at the Phase 3D Integration Laboratory in Orlando, Florida. (AMSAT-NA photo by Keith Baker, KB1SF)

- Power Supply : 12 Lithium batteries ( 3 groups in parallel of 4 batteries in series ).
- Battery Description: 3.5V, 9 AH (batteries are the same as the Mars Rover).
- Expected Lifetime : 1 month of active life. It should burn up on reentry after 1 or 1.5 years.
- Frequency: 145.820 MHz.
- Modulation: FM +/- 4 kHz.
- Audio: Audio frequency around 1 kHz versus internal temperature.

#### Conversion Table

#### Degrees Celsius Equals Hertz

|     |      |
|-----|------|
| 50  | 1360 |
| 30  | 1290 |
| 25  | 1261 |
| 10  | 1208 |
| 0   | 1131 |
| -10 | 1040 |
| -20 | 891  |
| -30 | 724  |
| -40 | 541  |

- Beep Duration: 1/6 seconds every 0.9 s.

- Transmitter: 48 MHz crystal oscillator( 2N2222), one tripler (BFY90) and one amplifier (BFR91).
- Beep: 2 x NE555.
- Official Name: Sputnik-40 Years or Spoutnik-40 Ans (French name).
- Project Name: PS2 (PS means simply *sputnik* in Russian, and in memory of PS1 the first Sputnik).
- Additional Name: Radio Sputnik (Amateur satellite) RS-17.
- NASA Catalog Number: 24958.

A more complete technical description of the satellite, dealing with its electronic, mechanical and thermal designs as well as its antenna patterns is available from AMSAT-France for a nominal donation (it is written in French). Contact them at: [amsat-f@amsat.org](mailto:amsat-f@amsat.org) for more details or visit AMSAT-F's WWW pages at: [http://www.ourworld.compuserve.com/homepages/AMSAT\\_F](http://www.ourworld.compuserve.com/homepages/AMSAT_F)

You can also visit the Reunion Island web site about Sputnik-40 at: <http://www.oceanes.fr/~fr5fc/spoutnik.htm>. Editor's Note: See page 21 for RS-17 Keplerian elements. ■

## 26th Annual SKN on OSCAR

You're most cordially invited to join in the 26th annual Straight Key Night on OSCAR, sponsored by AMSAT-NA for Amateur Radio satellite enthusiasts worldwide.

It's entirely unofficial: no rules, no scoring and no need to send in a log. Just call CQ SKN in the CW passband segment of any OSCAR satellite from 0000 to 2359 UTC on January 1, 1998, or answer a CQ SKN call from another station. OSCAR Zero (EME) contacts count too. Of course, all SKN operating must be done with a straight hand key.

Those participating are encouraged to nominate someone they worked for recognition as having the *best fist*. To send in a *best fist* nomination, please address it via e-mail to [w2rs@amsat.org](mailto:w2rs@amsat.org), via packet radio to W2RS @ WA2SNA or W2RS @ GB7HSN (whichever is closer to you), or via *snail-mail* to W2RS' callbook address. Those nominated will be featured in a bulletin sent to Amateur Radio publications and posted via ANS to packet radio and the Internet in early February. ■

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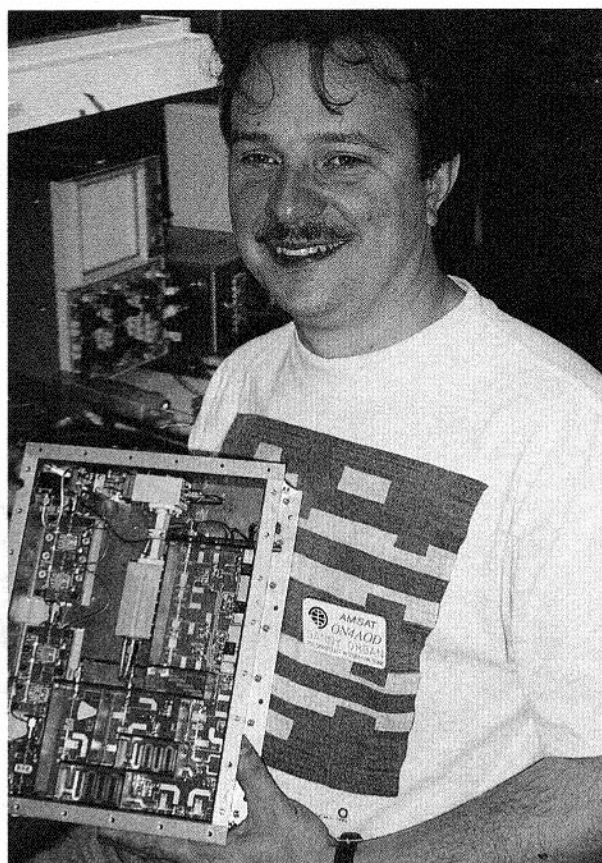
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Chuck Green, N0ADI, adjust the engineering copy of the Internal Housekeeping Unit (IHU) for the Phase 3D satellite. The IHU is Phase 3D's main computer and the engineering unit is being used in the spacecraft during ground tests to prevent possible damage to the flight unit during testing. (AMSAT-NA photo by Keith Baker, KB1SF)



Danny Orban, ON4AOD, poses with the fruits of his efforts, the 24 GHz final amplifier for Phase 3D. Danny was performing final bench testing of the transmitter at the Phase 3D Integration Laboratory in Orlando, Florida. (AMSAT-NA photo by Keith Baker, KB1SF)



Part of the international team that assembled at the Phase 3D Integration Laboratory, Orlando, Florida for structural upgrade and electronic integration work on the satellite. The team included participants from seven countries. (AMSAT-NA photo)



# IC-821H

**"By far the easiest to use satellite radio on the market today.** In less than 10 minutes after unpacking the 821H, I was on the air at 9600 baud with KO-23."

*—Michael Wyrick, N4USI  
AO-27 Control Operator*



## **QST** Magazine says:

"(The IC-821H) is a terrific dual-band multimode transceiver for all applications. Not only is the IC-821H an excellent VHF/UHF weak signal or contest radio, it is the cornerstone of a high-performance satellite station (digital or analog). Hams who have the Phase 3D satellite in mind will want to give serious consideration to the IC-821H. It also offers superb FM-voice and 9600-baud packet performance. Combine all of these features with the IC-821H's go-anywhere size and you have a radio that's ideal for almost any application above 144 MHz!"

— QST Magazine, March 1997  
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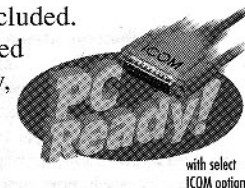
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